

Dimensions Underlying First Impressions of Older Adult Faces
by Young and Older Adult Perceivers

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Abstract

First Impressions (FIs) based on facial cues have significant consequences in real-world contexts and have the potential to influence how older adults (OAs), a vulnerable population, are treated by others. The present study used a data-driven approach to examine dimensions underlying FIs of OAs and whether those dimensions vary by perceiver age. In Experiment 1, young adult (YA) and OA participants provided unconstrained, written descriptions in response to OA faces. From these descriptors, 18 trait categories were identified that were similar, but not identical, across age groups. In Experiment 2, YA and OA participants rated OA faces on the trait words identified for their age group in Experiment 1. In separate principal components analyses, two dimensions of *sternness* and *confidence* emerged for OA faces for both YA and OA participant ratings. Our results suggest that there are no significant differences in perceiver age when forming first impressions of OA faces.

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Dimensions Underlying First Impressions of Older Adult Faces by Young and Older Adult Perceivers

Faces provide people with a multitude of informative cues, such as identity, age, sex, and ethnicity (Bruce & Young, 2012). People also rapidly form first impressions by inferring personality traits (e.g., trustworthiness, dominance, competence) and other characteristics (e.g., attractiveness, health) from facial cues (Willis & Todorov, 2006; Oosterhof & Todorov, 2008; Zebrowitz & Montpare, 2008; Rule et al., 2013; Sutherland et al., 2013; Sutherland et al., 2018). Formation of first impressions can occur within 100 milliseconds of viewing a new face (Willis & Todorov, 2006), these impressions tend to be stable across perceivers (Rule et al., 2013; Sutherland et al., 2020), and there is evidence that this occurs automatically (Ritchie et al., 2017; Thierry et al., 2021). Despite the ease with which we form first impressions, they are not always accurate (Rule et al., 2013); nonetheless, first impressions have a significant influence on people's behaviour towards others, having real-world consequences such as election results (Todorov et al., 2005; Antonakis & Dalgas, 2009; Castelli et al., 2009), criminal sentencing decisions (Wilson & Rule, 2015), hiring and promotion in the work place (Rule & Ambady, 2008, 2011; Graham et al., 2017), and emergency health care responses (Bagnis et al., 2020). The majority of studies have focused on first impressions of young adult (YA) faces; first impressions of older adults (OAs), a fast-growing age demographic, has received much less attention. The overarching goal of the present study is to determine the dimensions that underlie first impressions of older adult faces, and whether these dimensions differ by perceiver age (young vs. older adults).

A functional account of first impressions explains how these perceptions can be adaptive even though they are often inaccurate. First impressions reflect an overgeneralization of dynamic

facial cues such as emotion to infer stable traits (Oosterhof & Todorov, 2008; Adams et al., 2017). Oosterhof and Todorov's (2008) seminal work built an influential model of the functional basis of first impressions by examining the dimensions that underlie first impressions of young adult faces. They found that trustworthiness and dominance were the two main dimensions. Trustworthiness cues indicate whether an individual has the *intention* to help or harm, and dominance cues indicate whether they have the *ability* to carry out that action. Therefore, these cues allow us to detect whether someone poses a threat to us and whether we should approach or avoid them. These two dimensions appear to be stable across both sex and culture (South Palomares & Young, 2018; Sutherland et al., 2018; Wang et al., 2019). Importantly, Oosterhof and Todorov (2008) used a data-driven approach to determine these two dimensions, where no *a priori* decisions or hypotheses were made regarding what variables to include in the analysis. All data was driven by participants' responses—first through written responses to faces, and then subjecting ratings of trait words derived from those written descriptions to a dimension-reduction analysis.

Recently, Collova et al. (2019) employed a similar data-driven approach to test the functional account by examining the dimensions underlying adults' first impressions of child faces. They posited that finding different dimensions for child faces (as compared to YA faces) would support the functional account, since adults have different social goals when interacting with children vs. other adults, and it is not adaptive for adults to assess child faces for threat. They found that the dimensions underlying adults' first impressions of child faces are niceness and shyness. Collova et al. (2019) then collected ratings of trustworthiness and dominance for the child faces in order to correlate these YA dimensions with niceness and shyness; they found that niceness was highly related to trustworthiness, but shyness was not related to dominance.

Thus, their findings provide further evidence of a functional account of first impressions.

However, these findings also raise the question of what dimensions underlying first impressions of OA faces would emerge.

Given Collova et al.'s (2019) discovery that different dimensions underlie FIs of child vs. YA faces, it is important to take a data-driven approach to examine whether the dimensions underlying first impressions of OA faces differ from those underlying YA faces, and whether these dimensions vary by perceiver age (young vs. older adults). Developing an understanding of the dimensions underlying first impressions of OAs has important implications for this vulnerable population (e.g., in health care settings and retirement homes). Several findings suggest that first impressions are influenced by facial age. When a face set includes both YA and OA faces, a third dimension of youthful-attractiveness emerges along with the established two dimensions of trustworthiness/approachability and dominance, suggesting that age of face matters in forming first impressions (Sutherland et al., 2013). In a study examining the accuracy of first impressions, Zebrowitz et al. (2014) found that ratings of health are more accurate, and ratings of competence are less accurate, for OA as compared to YA faces. As well, OA faces are rated as significantly less attractive than those of YAs (Palumbo et al., 2017; Barber et al., 2019). According to the Stereotype Content Model of inter-group perceptions, OAs are seen as lower in competence and higher in warmth than YAs (Fiske et al., 2007). Palumbo et al. (2017) found that the lower perceived attractiveness of OA compared to YA faces contributes to the stereotype of lower competence of OAs. It is plausible to expect that individual perceptions of warmth and competence of OA faces would follow this same pattern as has been found in the Social Content Model. Considering the significant role that these attributes play in inter-group perceptions (e.g., status, competition; Fiske et al., 2007), it is important to explore the extent to which warmth and

competence underlie first impressions of individual OAs. The results of the current study will later allow for a direct comparison to be made between the dimensions that emerge for first impressions of OA faces to this influential social perception model.

There is mixed evidence about the extent to which FIs vary as a function of perceiver age. OAs are as accurate as YAs in recognizing threat from male facial cues, as measured through facial width-to-height ratio and ratings of aggressiveness (Boshyan et al., 2013). OAs are also similar to YAs in showing an emotion resemblance effect, whereby subtle emotional cues in neutral faces are overgeneralized to infer traits (e.g., a neutral face that resembles anger is perceived as low in trustworthiness and high in dominance; Franklin & Zebrowitz, 2013), and are just as accurate as YAs when forming first impressions of political affiliation and leadership ability (Krendl et al., 2014). Despite these similarities, there also appear to be slight differences in first impressions by OAs. Smailes et al. (2018) had both YA and OA participants judge faces on criminal appearance; they found that OAs were slower in making judgements of trustworthiness and were also less confident in their judgements compared to YAs. Although YAs and OAs showed high consensus in ratings of young and older faces on competence, health, hostility, and trustworthiness, there was greater within- than between-age agreement in ratings (Zebrowitz et al., 2013). Although OAs also show the attractiveness halo effect and the babyface stereotype that are both well-documented in YAs, both OAs and YAs showed stronger stereotypes for own-age faces than other-age faces (Zebrowitz & Franklin, 2014). The evidence that there is higher within- than between-age agreement in first impressions raises the possibility that the dimensions underlying first impressions of OA faces will differ by perceiver age.

Another difference is an OA positivity bias in first impressions (Castle et al, 2012; Zebrowitz et al., 2013; Zebrowitz & Franklin, 2014; Zebrowitz et al, 2016; Ng et al., 2016),

similar to that shown by OAs in cognitive processes such as memory and attention (Mather & Carstensen, 2005; Carstensen & Mikels, 2005). OAs have been found to rate untrustworthy looking faces as more trustworthy and approachable than YAs, and these perceptions are linked to less activation in the anterior insula for OAs, an area of the brain that helps us interpret “gut responses”; this bias may contribute to OAs increased vulnerability to fraud (Castle et al., 2012). When OAs are exposed to trustworthiness cues through facial appearance as well as reputation in an economic trust game, they are more likely than YAs to invest money with untrustworthy partners (Bailey et al, 2016). Zebrowitz et al. (2013) found that OAs rated faces more positively on health, hostility, and trustworthiness compared to YAs, and that this effect was driven by the negative end of the spectrum (e.g. higher ratings of health for the most unhealthy-looking faces). Based on these findings, it might be reasonable to expect that one way in which YA and OA dimensions could differ for first impressions of OA faces in the current study is by the language being used (more positive language by OA participants) which might influence the dimensions that emerge.

Though there is a growing body of research on both first impressions *of* OA faces and first impressions *by* OAs, these studies rely on the trait and attribute words used in YA first impressions and person perception research (e.g., trustworthiness), making the assumption that the same language is relevant to first impressions of and by OAs. Therefore, the goal of the present study was to use a data-driven approach to determine what trait words were most used to describe OA faces by both YA and OA participants, the dimensions formed by these trait words, and whether the language and dimensions for OA faces varied by perceiver age. In Experiment 1, YA and OA participants provided unconstrained descriptions in response to OA faces. These responses were analyzed to determine the most commonly used trait words for each age group.

In Experiment 2, YA and OA participants rated a series of faces on the most common trait words for their age group that emerged in Experiment 1. A principal components analysis was then conducted on the trait ratings of each age group to determine the dimensions underlying first impressions of OA faces, and whether they differ by perceiver age (YA vs. OA).

Experiment 1

Method

Participants. A total of 178 Caucasian participants (87 young adults, 91 older adults) were recruited both in person through the community and online. Young adult participants (65 females and 22 males; 18-28 years old; $M = 21.39$, $SD = 2.55$) were recruited in person on campus at Brock University ($n=32$) and through social media ($n=55$). Older adult community participants (63 females and 28 males; 65-90 years old; $M = 73.64$, $SD = 6.66$) were recruited in person at a senior's community centre in St. Catharines, Ontario ($n=9$) and through email invitations ($n=82$). Email invitations were sent to personal contacts, as well as through organizations including the Growing with Brock participant database at Brock University. In-person participants were compensated with a small gift (e.g., a choice of a pen or chocolate), and online participants were given the opportunity to enter a draw for a \$40 Amazon gift card. An additional 52 participants (40 YA, 12 OA) were excluded from analysis for the following reasons: did not self-identify as Caucasian (28 YA, 3 OA), provided no date of birth (DOB) or wrong DOB (e.g., gave the current year instead of birth year; 1 YA, 1 OA), were not in the age range specified in the instructions (2 YA, 2 OA), did not complete all answers or did not submit their responses (6 YA, 2 OA), gave the same answer for most or all questions or answers were unintelligible (3 YA, 1 OA), or did not reside in the US or Canada at time of testing (3 OA).

Stimuli. Colour photos of 56 Caucasian older adult faces were taken from the Center for Vital Longevity Face Database (Minear & Park, 2004). Photos were chosen from the database that met certain guidelines: against a plain white / off-white background, neutral expression, facing straight ahead (head tilted as little as possible), closed mouth, eyes open, minimal makeup (for females) and no facial hair (for males). All photos were cropped to a size of 419 x 419

pixels. The faces ranged in age from 70-91 ($M = 78.93$, $SD = 5.83$). Half of the photos were of female faces ($M = 78.61$, $SD = 5.79$, range = 70-89) and the other half were of male faces ($M = 79.25$, $SD = 5.97$, range = 70-91). Faces were pseudo-randomly split into seven different sets, each containing eight faces (four female and four male). Two additional photos that met the above criteria were chosen as practice faces and were shown to all participants.

Procedure. The study was run on Qualtrics (www.qualtrics.com), an online survey platform. After reading and agreeing to the informed consent statement, participants were given a short demographic questionnaire asking for date of birth, ethnicity, sex, and country of residence. Participants were then given instructions for completing the free descriptions. They were told to write down their first impressions for each face, and to write as much as came to mind until they could not think of anything more. They were told there were no right or wrong answers, so to rely on their “gut feeling” when giving their first impressions and to move on to the next face when their responses were no longer spontaneous (based on Collova et al., 2019; Oosterhof & Todorov, 2008; Sutherland et al., 2018). Altogether, each participant provided free descriptions for 10 faces. The first two faces were the practice faces presented in a random order, to help get the participant comfortable with the study. The responses to the practice faces were not analyzed. The participant was then randomly assigned by Qualtrics to one of the seven sets of faces, allowing them to see and respond to eight faces presented in a random order. Between 12 and 14 participants from each age group were assigned to each set. The project received clearance from the Research Ethics Board at Brock University.

Results and Discussion

Data analysis followed the same procedure used by Collova et al. (2019). Data consisted of the first impression descriptions provided by participants in response to the older adult faces.

These descriptions ranged from single word descriptors to multiple sentences. In the first step of analysis, these descriptions were broken down into words or phrases. In total, participants provided 4,741 descriptors (2,245 YA; 2,496 OA) for older adult faces. Two independent raters went through all descriptors and categorized them into the same main categories as Collova et al. (2019): traits (e.g., *friendly*), age (e.g., *old*), emotional state (e.g., *sad*), appearance (e.g., *blue eyes*), and sex (e.g., *woman*). Three additional categories were also added that seemed relevant to first impressions of older adults: cognitive state (e.g., *alert*), physical health (e.g., *unhealthy*), and attractiveness (e.g., *pretty*). Certain emotion words such as happy were also categorized as a trait when used by the participant to refer more to the face's character traits rather than to a transient state of feeling (e.g., if a participant used the phrase *happy go lucky*). Descriptors that did not fall into any of the main categories were placed in an *other* category (20%). These included statements regarding nationality/ethnicity, status/class, job/career, past life, activities/hobbies, family, and how the participant related to the target face (e.g., reminded them of someone they know). A coding frame was used to help maintain consistency. Interrater reliability was measured using Cohen's Kappa. The cognitive state category had moderate interrater reliability ($\kappa = .596, p < .001$) and the attractiveness category had low interrater reliability ($\kappa = .260, p < .001$). Cohen's Kappa showed high reliability for all other categories (emotional state: $\kappa = .760, p < .001$; appearance: $\kappa = .802, p < .001$; sex: $\kappa = .861, p < .001$; health: $\kappa = .716, p < .001$), including traits ($\kappa = .767, p < .001$; age: $\kappa = .947, p < .001$), the main focus of this study. A third independent rater resolved any disagreements in categorization. Since a goal of this study was to determine if there were differences in first impressions based on perceiver age, we calculated the percentages of descriptors in each category by age group (see Table 1). For total percentages (see Figure 1), traits comprised the largest category of descriptors

(39%), followed by appearance (16%), emotional state (9%), age (6%), sex (6%), physical health (6%), cognitive state (5%), and attractiveness (2%). These data confirm that both young and older adults spontaneously form first impressions of traits when viewing OA faces.

Table 1
Percentage for each age group of all descriptors that fall into the eight main categories plus other.

Descriptor Category	OA Percentage	YA Percentage	Total Percentage
Traits	41%	38%	39%
Appearance	16%	16%	16%
Emotional State	7%	10%	9%
Age	4%	9%	6%
Sex	4%	8%	6%
Physical Health	7%	5%	6%
Cognitive State	6%	4%	5%
Attractiveness	2%	2%	2%
Other	23%	18%	20%

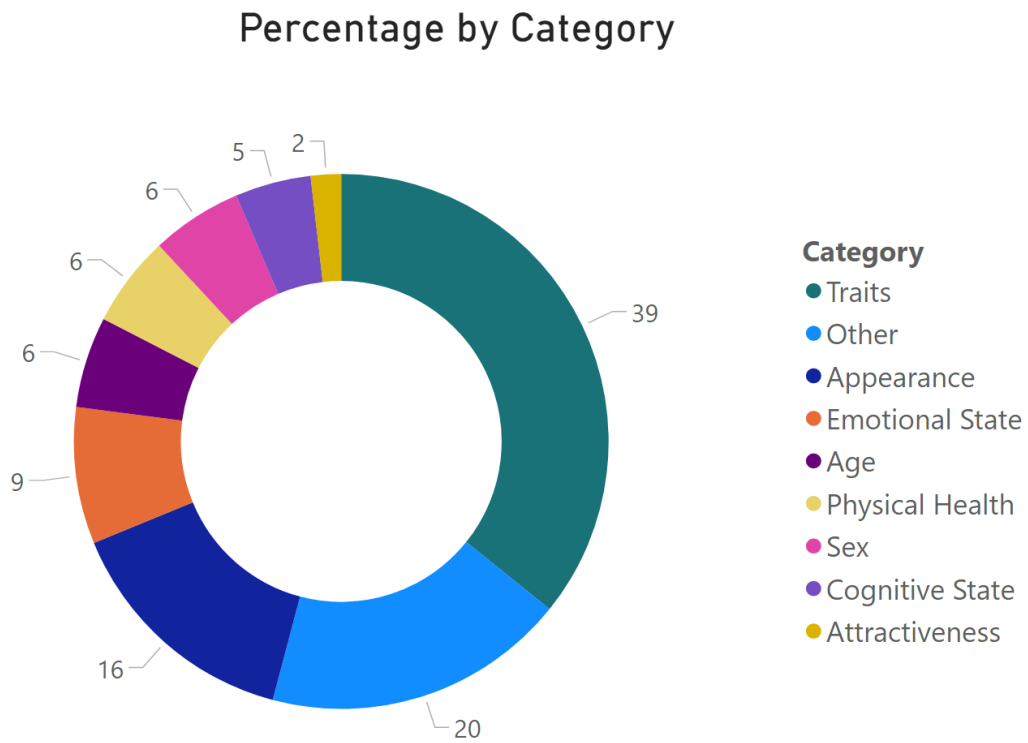


Figure 1. Percentage of all descriptors that fall into the eight main categories plus other, collapsed across young and older adults. Note: Percentages do not add up to 100% since some descriptors fell into more than one category.

All following analyses focused on the trait category of descriptors. YA participants provided 234 unique trait words (e.g., *kind*) and phrases (e.g., *sense of humour*), which were altogether used 649 times (repetition of the same word by the same participant was not counted). OA participants provided 302 unique trait words, which were used 824 times (again, by unique participants). See Figures 2 and 3 for word clouds of the trait words provided by YA and OA participants. In the next stage of analysis, trait words with the same root word were combined and labelled with the most used form of that trait word (e.g., *mistrusting*, *distrustful* and *untrusting* were all labeled *distrustful*, which occurred the most often). Three independent raters then took all trait words and organized them into categories of traits with similar (or antonymous) meanings. For example, *approachable*, *aloof*, and *friendly* were combined into a singular category. After the independent categorization, all three raters compared their categories. When at least two people agreed that a word should stay in a specific category, majority ruled, and the word stayed in that category. When all three raters had put words in different categories a discussion occurred, and the word was placed where all three agreed it fit best. If no unanimous agreement could be reached, the majority ruled (2 out of 3 in agreement). Twenty of the trait words (13 OA, 7 YA) were not placed into any category because they were either ambiguous (e.g., *religious*) or simply did not fit into any of the categories that emerged (e.g., *stylish*). This procedure led to 18 categories comprising trait words from both OA and YA participants.

We then separated data for young vs. older adults in order to examine the percentage of participants in each age group who used one or more trait words in each category (see Table 2). As in Collova et al., we labelled each category after the most used trait word in that category; given our interest in the effects of perceiver age, we did so separately for young vs. older adults.

For eight of the 18 categories the label was identical for young and older adults (i.e., the most used trait word in each category was the same for both age groups). The remaining nine categories had different labels for young vs. older adults. For example, while OAs most used the word *active*, YAs most used the word *energetic* which was in the same category as active (see Table 2). Following Collova et al. (2019), any categories that were used by less than 10% of participants were excluded from Experiment 2. Therefore, three categories were excluded for YA participants (*strong*, *lonely*, and *indifferent*) since less than 10% of YA participants used trait words in these categories. A total of 15 trait categories used by YA participants were retained for Experiment 2, while 18 trait categories were retained for OA participants. Participants in Experiment 2 rated faces on labels provided by their own age group to maintain the purity of the data-driven approach.

Table 2

Frequency with which unique participants used trait words in each category, sorted by highest to lowest frequency for YAs.

<u>Trait Category Name</u>		<u>Frequency</u>		<u>Percentage</u>	
OA	YA	OA	YA	OA	YA
Kind	Kind	38	54	0.42	0.62
Friendly	Friendly	53	48	0.58	0.55
Stern	Stern	34	42	0.37	0.48
Fun	Fun	45	36	0.49	0.41
Intelligent	Wise	39	30	0.43	0.34
Content	Content	33	30	0.36	0.34
Happy	Grumpy	25	30	0.27	0.34
Quiet	Quiet	30	29	0.33	0.33
Helpful	Caring	37	26	0.41	0.30
Opinionated	Judgemental	30	22	0.33	0.25
Confident	Confident	25	20	0.27	0.23
Honest	Genuine	24	20	0.26	0.23
Active	Energetic	27	17	0.30	0.20
Careful	Suspicious	33	11	0.36	0.13
Hard Working	Hard Working	23	11	0.25	0.13
Determined	Strong*	25	6	0.27	0.07*
Lonely	Lonely*	15	6	0.16	0.07*
Interested	Indifferent*	24	3	0.26	0.03*

**Categories less than 10% that were excluded from Experiment 2 for that age group*

Results followed the same pattern as found in Collova et al. (2019), with over 2,000 total number of descriptors (per age group in the current study), with traits comprising the largest category of descriptors for both YA and OA participants (28% in Collova, 39% in the current study). Older adults did appear to show a slight positivity bias, which can be seen by comparing the most common words used by OA vs YA in some categories. For example, whereas OAs used labels such as *happy*, *careful*, and *interested*, YAs used labels such as *grumpy*, *suspicious*, and *indifferent*, respectively (see Table 2). Nonetheless, the categories emerging from these two age groups were largely overlapping. These trait categories were then used in Experiment 2, where participants rated the same faces from Experiment 1 on the trait words that emerged for their age group.

Experiment 2

The purpose of Experiment 2 was to determine the dimensions underlying first impressions of OA faces by having both young and older adult participants rate the entire set of 56 faces on the trait categories identified in Experiment 1. YAs rated the faces on 15 categories and OAs rated the faces on 18 categories. The same trait label was provided to both groups for eight overlapping categories and age-specific trait labels (e.g., *intelligent* vs. *wise*) were provided for the remaining seven overlapping categories. Whereas Collova et al. (2019) found that attractiveness was frequently mentioned in adults' descriptions of child faces and included attractiveness as an attribute on which participants rated faces, we did not include attractiveness since it was rarely mentioned by either age group (2%) when describing OA faces in Experiment 1.

Method

Participants. A total of 1,180 participants (547 YAs and 633 OAs) were recruited online through email invitations and through the online participant databases Amazon Mechanical Turk (www.mturk.com), Testable Minds (www.testable.org), and Prolific (www.prolific.co). Young adult participants (340 females, 206 males, 1 other; 18-27 years old; $M = 22.27$, $SD = 3.07$) were recruited through social media ($n=2$), the undergraduate research participation pool at Brock ($n=107$), Mturk ($n=11$), Testable Minds ($n=237$), and Prolific ($n=190$). Older adult participants (377 females and 256 males; 64-95 years old; $M = 69.41$, $SD = 4.42$) were recruited through email invitations sent to personal contacts as well as the Growing with Brock participant database ($n=97$), MTurk ($n=236$), and Prolific ($n=300$). We began with Mturk to recruit both younger and older adults but found that the data quality was not strong (i.e., there was a large number of responses that were excluded for failing the attention checks). We also used Testable

Minds for YA participants since it provides high quality data, but the pool is small. Therefore, we ended up collecting the rest of the data on Prolific since it provides high quality data from both young and older adults. An additional 584 participants (199 YAs, 397 OAs) were excluded for the following reasons: failed the memory attention check (116 YA, 237 OA; see procedure), did not complete or withdrew from the study (41 YA, 70 OA), attempted the survey more than once (54 OA), age / date of birth (e.g, was outside the specified age range; 8 YA, 22 OA), ethnicity (e.g., did not identify as Caucasian; 15 YA, 5 OA), country (e.g., did not reside in Canada, the US, or the UK; 5 YA), provided all the same answers (4 YA, 9 OA), or experienced an issue with the survey (10 YA). Participants were recruited from Canada, the US, and the UK. Community participants were given the opportunity to enter a draw for a chance to win a \$40 gift card, and participants from the online databases were compensated with \$2.00 USD for the 15-minute survey.

Stimuli. The same 56 images of older adult faces were used as in Experiment 1.

Procedure. The study was run through Qualtrics (www.qualtrics.com), an online survey platform. After reading and agreeing to the informed consent statement, participants were given a short demographic questionnaire asking for date of birth, ethnicity, sex, and country of residence. Participants were then randomly assigned to rate all 56 faces on one of the trait labels derived from Experiment 1, which slightly differed for young vs. older adults. YA raters were assigned one of the 15 trait category words produced by YA participants from Experiment 1: energetic, suspicious (of others), caring, confident, content, friendly, fun, grumpy, hardworking, kind, judgemental, quiet, stern, genuine, and wise. OA raters were assigned one of the 18 trait category words produced by OA participants from Experiment 1: active, careful, helpful, confident, content, determined, friendly, fun, happy, hard working, interested, kind, lonely,

opinionated, quiet, stern, honest, and intelligent. Each trait was rated on a scale from 1 (not at all *trait*) to 9 (extremely *trait*). At the beginning of the ratings, participants were shown the two practice faces in a random order and were asked to rate those faces on the same trait. A minimum of 30 participants in each age group rated the faces for each trait word.

Each face was shown (in a random order) in the center of a white screen, with the rating scale beneath and the question “How *trait* is this older adult?” presented above. The face remained on the screen until the participant responded and moved to the next page. Three attention checks were included throughout the experiment to ensure that participants were paying attention to the instructions and were rating the faces on the trait word they were assigned. The first two, presented at the beginning and half-way through the ratings, explicitly told participants what word they were rating faces on, and asked participants to type that trait word in the provided text box. The last attention check, after ratings were completed, was memory-based and asked participants to “please type in the exact trait word that you were rating faces on”. This last attention check was used as the main exclusion criteria. Data was used for participants who provided the exact trait word or some form of the trait word (e.g., if they wrote *kindness* when the word was *kind*) in this memory attention check.

At the end of the survey, participants were asked to complete a short questionnaire assessing their experiences with, and attitudes towards, older adults (adapted from Collova et al., 2019; see Appendix A). The questionnaire consisted of eight questions and required participants to respond on a scale from 1 (very strongly disagree) to 6 (very strongly agree). The analysis of the questionnaire data will contribute to a separate manuscript.

Results and Discussion

Data Analysis. We performed a principal components analysis (PCA) separately for YA and OA mean ratings on all trait words to determine the dimensions underlying first impressions of OA faces. Cronbach's alpha showed good interrater reliability for the trait ratings (all alphas were $> .7$, Nunally, 1978; see Tables 3 and 4). A PCA was conducted on the average ratings for each of the 15 and 18 trait words, for YAs and OAs respectively, using an oblique (promax) rotation. For both YA and OA data the majority of the coefficients in the correlation matrices were $.3$ or above, the Kaiser-Meyer-Olkin value was $.899$ and $.877$, respectively (greater than the recommended value of $.6$; Kaiser, 1960; Kaiser & Rice, 1974), and Bartlett's test of sphericity was significant (for YAs: $\chi^2 = 1238.277$, $df = 105$, $p < .001$; for OAs: $\chi^2 = 1526.591$, $df = 153$, $p < .001$), all demonstrating that the data were suitable for a PCA (see Tables 5 and 6 for correlation matrices and Appendix B for communalities). Three methods were used to determine the number of dimensions to retain: Kaiser's criterion of eigenvalues > 1 , the scree plot, and a parallel analysis (see Table 7). Based on the information from these methods, a two-component solution was chosen for both the YA and OA data (see Appendix C for the initial solutions based on the eigenvalues).

Table 3

Interrater reliability for YA ratings

Trait Dimension	Reliability (Cronbach's α)	Sample size (n)
Caring	.953	32
Confident	.924	34
Content	.921	34
Energetic	.972	32
Friendly	.947	32
Fun	.947	30
Genuine	.939	31
Grumpy	.964	34
Hard Working	.835	32
Judgemental	.958	32
Kind	.937	32
Quiet	.772	31
Stern	.934	37
Suspicious	.968	32
Wise	.950	31

Table 4

Interrater reliability for OA ratings

Trait Dimension	Reliability (Cronbach's α)	Sample size (n)
Active	.975	33
Careful	.938	30
Confident	.935	30
Content	.921	34
Determined	.948	33
Friendly	.950	30
Fun	.973	32
Happy	.947	33
Hard working	.971	31
Helpful	.970	30
Honest	.967	30
Intelligent	.947	34
Interested	.955	35
Kind	.960	31
Lonely	.957	32
Opinionated	.902	35
Quiet	.912	30
Stern	.967	30

Table 5
Correlation matrix for average ratings of YA trait words

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Caring	-														
2. Confident	0.48**	-													
3. Content	0.89**	0.58**	-												
4. Energetic	0.64**	0.71**	0.76**	-											
5. Friendly	0.95**	0.54**	0.92**	0.73**	-										
6. Fun	0.88**	0.55**	0.93**	0.78**	0.94**	-									
7. Genuine	0.92**	0.43*	0.83**	0.55**	0.89**	0.82**	-								
8. Grumpy	-0.91**	-0.43*	-0.94**	-0.69**	-0.92**	-0.91**	-0.87**	-							
9. Hardworking	0.2	0.44*	0.17	0.29*	0.19	0.2	0.19	-0.16	-						
10. Judgemental	-0.80**	-0.21	-0.81**	-0.51**	-0.80**	-0.77**	-0.79**	0.90**	-0.13	-					
11. Kind	0.92**	0.46**	0.89**	0.63**	0.95**	0.89**	0.90**	-0.91**	0.27	-0.85**	-				
12. Quiet	0.17	-0.31*	-0.06	-0.40*	0.03	-0.08	0.22	-0.08	0.11	-0.25	0.11	-			
13. Stern	-0.84**	-0.33*	-0.89**	-0.66**	-0.87**	-0.86**	-0.85**	0.93**	-0.1	0.90**	-0.90**	-0.07	-		
14. Suspicious	-0.77**	-0.38*	-0.74**	-0.54**	-0.79**	-0.72**	-0.79**	0.79**	-0.25	0.83**	-0.83**	-0.23	0.82**	-	
15. Wise	0.60**	0.54**	0.52**	0.44*	0.61**	0.60**	0.62**	-0.50**	0.66**	-0.45**	0.63**	0.25	-0.46**	-0.63**	-

Note: n = 56; * p < .05, ** p < .001 (both 2-tailed); coefficients over .3 are bolded

Table 6
Correlation matrix for average ratings of OA trait words

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Active	-																	
2. Careful	0.68**	-																
3. Confident	0.70**	0.69**	-															
4. Content	0.49**	0.27*	0.27*	-														
5. Determined	0.12	0.22	0.39*	-0.56**	-													
6. Friendly	0.47**	0.23	0.25	0.94**	-0.55**	-												
7. Fun	0.44*	0.18	0.19	0.96**	-0.61**	0.97**	-											
8. Happy	0.43*	0.18	0.24	0.97**	-0.54**	0.94**	0.95**	-										
9. Hardworking	0.22	0.47**	0.54**	0.12	0.29*	0.15	0.11	0.09	-									
10. Helpful	0.65**	0.50**	0.43*	0.92**	-0.45*	0.90**	0.88**	0.87**	0.20	-								
11. Honest	0.21	0.37*	0.20	0.72**	-0.46**	0.71**	0.69**	0.67**	0.27*	0.71**	-							
12. Intelligent	0.69**	0.78**	0.72**	0.41*	0.11	0.41*	0.31*	0.33*	0.45**	0.57**	0.46**	-						
13. Interested	0.57**	0.38*	0.41*	0.83**	-0.22	0.83**	0.80**	0.82**	0.36*	0.82**	0.67**	0.58**	-					
14. Kind	0.36*	0.24	0.18	0.94**	-0.63**	0.94**	0.95**	0.93**	0.14	0.88**	0.81**	0.37*	0.77**	-				
15. Lonely	-0.71**	-0.52**	-0.50**	-0.87**	0.26	-0.80**	-0.81**	-0.83**	-0.19	-0.86**	-0.62**	-0.54**	-0.8**	-0.77**	-			
16. Opinionated	0.06	0.12	0.30*	-0.71**	0.83**	-0.68**	-0.70**	-0.68**	0.17	-0.57**	-0.63**	0.02	-0.43*	-0.77**	0.40*	-		
17. Quiet	-0.57**	-0.31*	-0.34*	-0.52**	0.02	-0.49**	-0.51**	-0.53**	-0.02	-0.52**	-0.28*	-0.30*	-0.56**	-0.46**	0.67**	0.09	-	
18. Stern	-0.24	-0.01	0.03	-0.88**	0.77**	-0.90**	-0.92**	-0.88**	0.02	-0.79**	-0.69**	-0.18	-0.69**	-0.93**	0.65**	0.84**	0.34*	-

Note: n = 56; * p < .05, ** p < .001 (both 2-tailed); coefficients over .3 are bolded

Table 7
Number of components to retain by each method

	YA PCA	OA PCA
Kaiser's Criterion	3	3
Scree Test	1 or 2	2 or 3
Parallel Analysis	2	2

Results. When examining the pattern matrix for the YA two-component solution (see Table 8), 11 items loaded strongly ($> .4$) on component one (seven positively and four negatively). The highest loading variable on component one was *judgemental*. For component two, four items loaded strongly ($> .4$; three positively and one negatively). The highest loading variable on component two was *quiet*. The two components were correlated at .411. When examining the pattern matrix for the OA two-component solution (see Table 9), 12 items loaded strongly ($> .4$) on component one (eight positively and four negatively). The highest loading variable on component one was *stern*. For component two, six items loaded strongly ($> .4$; five positively and one negatively), and the highest loading variable on component two was *confident*. The two components were correlated at .304.

Although the highest loading variables on each component varied with perceiver age, Tables 8 and 9 show high similarity across age groups. *Judgemental/opinionated*, *stern* and *kind* loaded highly on component one for both age groups; likewise, *confident*, *energetic/active*, and *quiet* loaded highly on component two for both age groups. To verify that the PCA solutions for both YA and OA participants were very similar, we calculated component scores for each of the 56 faces using the regression method in SPSS; separate scores were calculated for the YA and OA dimensions, resulting in four component scores for each face. The face component scores on dimension 1 ($r = .936, p = < .001$) and dimension 2 ($r = .755, p = < .001$) were highly correlated between age groups.

Following the approach taken by other first impressions researchers (Sutherland et al., 2013; Sutherland et al., 2018; Collova et al., 2019) in order to be able to compare with significant models in the field (e.g., Oosterhof & Todorov, 2008), we also conducted PCA analyses using an orthogonal (varimax) rotation. The results were highly similar to the original

PCAs using oblique rotation for both the YA and OA data, with Kaiser's criterion, the scree plot and parallel analysis leading to a two-component solution (see Appendix D).

Discussion. The two-component PCA for YA and OA data resulted in extremely similar solutions. For component one, variables that elicited positive judgements loaded positively (e.g., kind, friendly, content) and those that elicited negative judgements loaded negatively (e.g., stern, judgemental, opinionated) for both YAs and OAs. *Stern* was the highest loading trait word in common on component one for both the YA (third highest loading, -.965) and OA (first highest loading, -1.016) solutions; therefore we termed the first component *sternness*. For component two, common words again loaded strongly for both YAs and OAs (e.g., quiet, confident, hardworking). *Confident* was the highest loading trait word in common on component two for both the YA (second highest loading, .815) and OA (first highest loading, .933) solutions, therefore we termed the second component *confidence*. Based on the high correlations between the YA and OA dimensions, we can conclude that these dimensions are analogous to each other.

Table 8
Pattern matrix for YA PCA

	Component 1	Component 2
Judgemental	-1.007	0.264
Genuine	0.965	-0.087
Stern	-0.965	0.075
Grumpy	-0.963	0.002
Kind	0.958	0.017
Caring	0.948	0.002
Suspicious	-0.917	0.109
Friendly	0.909	0.125
Content	0.850	0.200
Fun	0.827	0.239
Wise	0.561	0.219
Quiet	0.500	-0.832
Confident	0.148	0.815
Energetic	0.413	0.665
Hardworking	0.072	0.428

Note: coefficients over .4 are bolded

Table 9
Pattern matrix for OA PCA

	Component 1	Component 2
Stern	-1.016	0.221
Kind	0.967	0.024
Fun	0.959	0.038
Opinionated	-0.942	0.495
Content	0.935	0.124
Happy	0.934	0.071
Friendly	0.927	0.11
Determined	-0.854	0.606
Helpful	0.799	0.342
Honest	0.739	0.118
Interested	0.683	0.406
Lonely	-0.667	-0.466
Confident	-0.132	0.933
Careful	-0.053	0.861
Intelligent	0.105	0.814
Active	0.164	0.788
Hardworking	-0.118	0.617
Quiet	-0.362	-0.407

Note: coefficients over .4 are bolded

General Discussion

First impressions influence our behaviour towards others, making it imperative that we understand how first impressions are formed of individuals in vulnerable groups such as older adults. Based on the stereotype literature, we know that OAs already experience patronizing behaviour from others (Barber et al., 2019). According to the Stereotype Content Model, as a group OAs are viewed as higher in warmth and lower in competence in comparison to YAs, which may lead to lower employment opportunities and being perceived as low in social status (Fiske et al, 2007; Barber et al., 2019). While first impressions focus on perceptions of individuals rather than groups, it is likely that differences in perceptions of warmth and competence across individual older adults have similar consequences. The present study used a data-driven approach to examine whether the dimensions underlying impressions of OA faces differ from those of YA faces. These findings will also allow us to understand more fully what types of first impressions are formed of OA faces and provide opportunities to examine how these first impressions may influence behaviour towards OAs in their daily life.

In Experiment 1, OA and YA participants provided free, unconstrained descriptions in response to OA faces. These descriptions were broken down into words and phrases and categorized by the attribute they referenced. The largest category consisted of words referencing personality traits, confirming that both young and older adults spontaneously form first impressions of traits from OA faces. This category was the subject of all further analyses. Trait words with the same root word were combined and then placed into categories of words with similar (and antonymous) meanings. Finally, each trait category was named after the most common occurring word, which differed for several categories by age group, with OAs producing more positive trait words. In Experiment 2, OA and YA participants rated OA faces

on the trait category words derived from same-aged participants in Experiment 1, and a PCA was conducted on the average ratings for each face on each trait word. The PCAs for both YA and OA ratings led to a two-component solution, with words such as *stern*, *friendly*, *kind*, and *judgmental* loading onto the first component for both age groups. We named this first component *sternness*, as this was the highest loading variable in common for OAs and YAs. Words such as *confident*, *quiet*, and *hardworking* loaded highly onto the second component for both OAs and YAs, and we named this component *confidence*, as this was the highest loading variable in common for both age groups.

Our results suggest that there are no significant differences as a function of perceiver age when forming first impressions of OA faces; the dimensions for both YA and OA raters were extremely similar even when different language was being used. Correlation of the dimensions using component scores confirmed that these dimensions underlying first impressions of older faces are comparable across age groups, with both the sternness and confidence dimensions being highly correlated between YA and OA ratings.

One limitation of the current study is that it remains unclear whether the dimensions underlying FIs of OA faces are comparable to those underlying FIs of YA faces. To address this limitation we are currently comparing the dimensions found in the present study to those in other influential models of person perception, including trustworthiness and dominance, warmth and competence, shyness and niceness, and other physical facial cues such as health, attractiveness, and babyfacedness (Oosterhof & Todorov, 2008; Fiske et al., 2007; Collova et al., 2019; Sutherland et al., 2016). In that study a new group of participants will rate all OA faces from Experiments 1 and 2 on these additional attributes. The score for each face on the new attributes

rated will be correlated with scores for each face on the two dimensions identified in Experiment 2.

Based on previous findings, it is likely that the sternness dimension found in the present study is highly correlated with trustworthiness, warmth, and niceness. Words that loaded highly on the sternness dimension (i.e., kind, friendly, fun) also loaded highly on the niceness dimension for children's faces; this niceness dimension is highly correlated with trustworthiness (Collova et al., 2019). Words that loaded highly on the sternness dimension also loaded highly on the trustworthiness dimension for YA faces—for example, *friendly* and *happy* vs. *sociable* and *unhappy*, respectively (Oosterhof & Todorov, 2008). The trustworthiness and sternness dimensions also share the word *caring* as a highly loading variable. As well, Sutherland et al. (2016) found that first impressions of trustworthiness are closely related to perceptions of warmth as defined in the Social Content Model of inter-group perceptions (Fiske et al., 2007), demonstrating that trustworthiness and warmth are providing similar cues (e.g., valence, approach vs. avoidance), and influence both individual and group perceptions.

It is less clear how impressions around dominance, competence, and shyness are related, and the extent to which the confidence dimension from the current study would correlate with them. In Collova et al.'s (2019) study investigating first impressions of child faces, there was no significant relationship between dominance and shyness which supports the functional theory; it does not evolutionarily make sense for adults to assess children's faces for dominance or threat. Sutherland et al. (2016) found that there was only a moderate relationship between dominance and competence for adult faces (they used a set of faces that varied in age from young to older adult). The functional account describes first impressions of dominance as assessing another's ability to carry out an action, whether to help or harm us. An explanation provided by Sutherland

et al. (2016) is that “dominance and competence may reflect different routes to achieving the capability to be able to help or harm the observer” (p. 265). Specifically, competence and dominance could both lead to status and power depending on the context in which behaviour occurs. For example, competence is related to success in politics while dominance is related to success in the military (Chiao et al., 2008; Mueller & Mazur, 1996; Sutherland et al., 2016). The question then arises of how the dimension of confidence for OA faces is related to dominance and competence; considering some of the words that loaded onto the confidence dimension (e.g., active/energetic, hardworking, intelligent), we might expect that confidence would be more highly related to competence than dominance (e.g., in contexts such as politics).

A second limitation is that we have not yet examined the robustness and specificity of the dimensions discovered. In future studies, using composite faces high and low on each dimension of sternness and confidence, and morphing other faces towards the high and low composites, will help us test whether participants can differentiate between the dimensions themselves (e.g., between a high stern face and a high confidence face) as well as between faces high and low on each dimension (e.g., a high stern face and a low stern face). A third limitation is that we used tightly controlled images that did not capture all of the ways a face can vary. In an ongoing study we are testing the robustness of the dimensions by using ambient images in which faces vary in multiple ways (e.g., lighting, pose, facial expression, etc.); participants are rating these naturalistic images on the same trait words as in Experiment 2. If the same dimensions of sternness and confidence emerge, we can conclude that these dimensions are stable and robust.

Implications of the current research include finding ways to reduce the negative impact that first impressions can have on behaviour towards older adults—a vulnerable population and the fastest growing age demographic in Canada (Statistics Canada, 2011). OAs interact with new

people in their community every day in health care settings, community centres, at the grocery store, or in retirement homes. Therefore, it is important to understand what types of first impressions are formed of OA faces, and how these perceptions influence behaviour towards OAs in order to increase well-being in daily interactions.

In conclusion, our study has been the first to identify the dimensions underlying first impressions of OA faces, and to test whether these dimensions differ by perceiver age. OAs and YAs form similar first impressions of OA faces, despite use of slightly different language to describe them and the primary dimension—sternness—appears very similar to the primary dimension underlying first impressions of both adult and child faces.

References

- Adams, R. B., Albohn, D. N., & Kveraga, K. (2017). Social vision: Applying a social-functional approach to face and expression perception. *Current Directions in Psychological Science*, 26(3), 243–248. <https://doi.org/10.1177/0963721417706392>
- Antonakis, J., & Dalgas, O. (2009). Predicting elections: Child's play! *Science*, 323, 1183. <https://doi.org/10.1126/science.1167748>
- Bagnis, A., Caffo, E., Cipolli, C., De Palma, A., Farina, G., & Mattarozzi, K. (2020). Judging health care priority in emergency situations: Patient facial appearance matters. *Social Science & Medicine*, 260, 113180-. <https://doi.org/10.1016/j.socscimed.2020.113180>
- Bailey, P. E., Szczap, P., McLennan, S. N., Slessor, G., Ruffman, T., & Rendell, P. G. (2016). Age-related similarities and differences in first impressions of trustworthiness. *Cognition and Emotion*, 30(5), 1017–1026. <https://doi.org/10.1080/02699931.2015.1039493>
- Barber, S., Lee, H., Becerra, J., & Tate, C. (2019). Emotional expressions affect perceptions of younger and older adults' everyday competence. *Psychology and Aging*, 34(7), 991–1004. <https://doi.org/10.1037/pag0000405>
- Boshyan, J., Zebrowitz, L. A., Franklin, R. G., McCormick, C. M., & Carré, J. M. (2014). Age similarities in recognizing threat from faces and diagnostic cues. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, 69(5), 710–718. <https://doi.org/10.1093/geronb/gbt054>
- Bruce, V. & Young, A. W. (2012). *Face perception*. London, England: Psychology Press.
- Carstensen, L. L. & Mikels, J. A. (2005). At the intersection of emotion and cognition aging and the positivity effect. *Current Directions in Psychological Science*, 14(3), 117-121. <https://doi.org/10.1111/j.0963-7214.2005.00348.x>

- Castelli, L., Carraro, L., Ghitti, C., & Pastore, M. (2009). The effects of perceived competence and sociability on electoral outcomes. *Journal of Experimental Social Psychology, 45*(5), 1152–1155. <https://doi.org/10.1016/j.jesp.2009.06.018>
- Castle, E., Eisenberger, N. I., Seeman, T. E., Moons, W. G., Boggero, I. A., Grinblatt, M. S., & Taylor, S. E. (2012). Neural and behavioral bases of age differences in perceptions of trust. *Proceedings of the National Academy of Sciences of the United States of America, 109*(51), 20848–20852. <https://doi.org/10.1073/pnas.1218518109>
- Chiao, J., Bowman, N., & Gill, H. (2008). The political gender gap: Gender bias in facial inferences that predict voting behavior. *PloS One, 3*(10), 1-7. <https://doi.org/10.1371/journal.pone.0003666>
- Collova, J. R., Sutherland, C. A., & Rhodes, G. (2019). Testing the functional basis of first impressions: Dimensions for children’s faces are not the same as for adults’ faces. *Journal of Personality and Social Psychology, 117*(5), 900-924. <https://doi.org/10.1037/pspa0000167>
- Fiske, S. T., Cuddy, A. J. C., & Glick, P. (2007). Universal dimensions of social cognition: Warmth and competence. *Trends in Cognitive Sciences, 11*(2), 77–83. <https://doi.org/10.1016/j.tics.2006.11.005>
- Franklin, R. G., & Zebrowitz, L. A. (2013). Older adults’ trait impressions of faces are sensitive to subtle resemblance to emotions. *Nonverbal Behaviour, 37*, 139-151. <https://doi.org/10.1007/s10919-013-0150-4>
- Graham, J. R., Harvey, C. R., & Puri, M. (2017). A corporate beauty contest. *Management Science, 63*(9), 3044-3056. <https://doi.org/10.1287/mnsc.2016.2484>
- Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and*

- Psychological Measurement*, 20, 141-151. <https://doi.org/10.1177/001316446002000116>
- Kaiser, H. F. & Rice, J. (1974). Little jiffy, mark IV. *Educational and Psychological Measurement*, 34, 111-117. <https://doi.org/10.1177/001316447403400115>
- Krendl, A. C., Rule, N. O., & Ambady, N. (2014). Does aging impair first impression accuracy? Differentiating emotion recognition from complex social inferences. *Psychology and Aging*, 29(3), 482–490. <https://doi.org/10.1037/a0037146>
- Mather, M. & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences*, 9(10), 496-502.
<https://doi.org/10.1016/j.tics.2005.08.005>
- Miner, M. & Park, D.C. (2004). A lifespan database of adult facial stimuli. *Behavior Research Methods, Instruments, & Computers*, 36, 630-633.
- Mueller, U. & Mazur, A. (1996). Facial dominance of West Point cadets as a predictor of later military rank. *Social Forces*, 74(3), 823–850. <https://doi.org/10.1093/sf/74.3.823>
- Ng, S. Y., Zebrowitz, L. A., & Franklin, R. G. (2016). Age differences in the differentiation of trait impressions from faces. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, 71(2), 220–229. <https://doi.org/10.1093/geronb/gbu113>
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York, NY: McGraw-Hill.
- Oosterhof, N. N. & Alexander Todorov. (2008). The functional basis of face evaluation. *Proceedings of the National Academy of Sciences of the United States of America*, 105(32), 11087–11092. <https://doi.org/10.1073/pnas.0805664105>
- Palumbo, R., Adams, Jr., R. B., Hess, U., Kleck, R. E., Zebrowitz, L. (2017). Age and gender differences in facial attractiveness, but not emotion resemblance, contribute to age and

- gender stereotypes. *Frontiers in Psychology*, 8, 1704-1704.
<https://doi.org/10.3389/fpsyg.2017.01704>
- Ritchie, K. L., Palermo, R. & Rhodes, G. (2017). Forming first impressions of facial attractiveness is mandatory. *Scientific Reports*, 7(1), 469-. <https://doi.org/10.1038/s41598-017-00526-9>
- Rule, N. O., & Ambady, N. (2008). The face of success: Inferences from chief executive officers' appearance predict company profits: Short report. *Psychological Science*, 19(2), 109–111. <https://doi.org/10.1111/j.1467-9280.2008.02054.x>
- Rule, N. O., & Ambady, N. (2011). Judgments of power from college yearbook photos and later career success. *Social Psychological and Personality Science*, 2(2), 154–158.
<https://doi.org/10.1177/1948550610385473>
- Rule, N. O., Krendl, A. C., Ivcevic, Z., & Ambady, N. (2013). Accuracy and consensus in judgments of trustworthiness from faces: Behavioral and neural correlates. *Journal of Personality and Social Psychology*, 104(3), 409–426. <https://doi.org/10.1037/a0031050>
- Smailes, H. L., Humphries, J. E., Ryder, H., Klatt, T., Maltby, J., Pearmain, A. M., & Flowe, H. D. (2018). Age-related differences in spontaneous trait judgments from facial appearance. *Psychiatry, Psychology and Law*, 25(5), 759–768.
<https://doi.org/10.1080/13218719.2018.1477633>
- South Palomares, J., Sutherland, C., & Young, A. (2018). Facial first impressions and partner preference models: Comparable or distinct underlying structures? *The British Journal of Psychology*, 109(3), 538–563. <https://doi.org/10.1111/bjop.12286>
- Statistics Canada. (2011). *The Canadian Population in 2011: Age and Sex*.
<https://doi.org/Catalogue no. 98 -311-X2011001>

- Sutherland, C. A., Oldmeadow, J. A., Santos, I. M., Towler, J., Burt, D. M., & Young, A. W. (2013). Social inferences from faces: Ambient images generate a three-dimensional model. *Cognition*, *127*(1), 105-118. <https://doi.org/10.1016/j.cognition.2012.12.001>
- Sutherland, C. A., Oldmeadow, J. A., & Young, A. W. (2016). Integrating social and facial models of person perception: Converging and diverging dimensions. *Cognition*, *157*, 257–267. <https://doi.org/10.1016/j.cognition.2016.09.006>
- Sutherland, C. A., Liu, X., Zhang, L., Chu, Y., Oldmeadow, J. A. & Young, A. W. (2018). Facial first impressions across culture: Data-driven modeling of Chinese and British perceivers' unconstrained facial impressions. *Personality and Social Psychology Bulletin*, *44*(4), 521-537. <https://doi.org/10.1177/0146167217744194>
- Sutherland, C. A., Rhodes, G., Burton, N. S., & Young, A. W. (2020). Do facial first impressions reflect a shared social reality? *British Journal of Psychology*, *111*(2), 215-232. <https://doi.org/10.1111/bjop.12390>
- Tabachnick, B.G & Fidell, L. S. (2013). *Using multivariate statistics* (Sixth edition.). Pearson.
- Thierry, S. M., Twele, A. C. & Mondloch, C. J. (2021). Mandatory first impressions: Happy expressions increase trustworthiness ratings of subsequent neutral images. *Perception* *50*(2), 103-115. <https://doi.org/10.1177/0301006620987205>
- Todorov, A., Mandisodza, A. N., Goren, A., & Hall, C. C. (2005). Inferences of competence from faces predict election outcomes. *Science*, *308*(5728), 1623–1626. <https://doi.org/10.1126/science.1110589>
- Wang, H., Han, C., Hahn, A., Fasolt, V., Morrison, D., Holzleitner, I., DeBruine, L., & Jones, B. (2019). A data-driven study of Chinese participants' social judgments of Chinese

faces. *PloS One*, *14*(1), e0210315–e0210315.

<https://doi.org/10.1371/journal.pone.0210315>

Willis, J., & Todorov, A. (2006). First impressions: Making up your mind after a 100-ms exposure to a face. *Psychological Science*, *17*, 592–98. <https://doi.org/10.1111/j.1467-9280.2006.01750.x>

Wilson, J. P., & Rule, N. O. (2015). Facial trustworthiness predicts extreme criminal-sentencing outcomes. *Psychological Science*, *26*(8), 1325–1331.

<https://doi.org/10.1177/0956797615590992>

Zebrowitz, L. A., & Montepare, J. M. (2008). Social psychological face perception: Why appearance matters. *Social and Personality Psychology Compass*, *2*(3), 1497–1517.

<https://doi.org/10.1111/j.1751-9004.2008.00109.x>

Zebrowitz, L. A. & Franklin, R. G. (2013). Older adults' trait impressions of faces are sensitive to subtle resemblance to emotions. *Journal of Nonverbal Behavior*, *37*(3), 139-151.

<https://doi.org/10.1007/s10919-013-0150-4>

Zebrowitz, L. A., Franklin, R. G., Hillman, S., & Boc, H. (2013). Older and younger adults' first impressions from faces: Similar in agreement but different in positivity. *Psychology and Aging*, *28*(1), 202–212. <https://doi.org/10.1037/a003092>

Zebrowitz, L. A., & Franklin, R. G. (2014). The attractiveness halo effect and the babyface stereotype in older and younger adults: Similarities, own-age accentuation, and older adult positivity effects. *Experimental Aging Research*, *40*(3), 375–393.

<https://doi.org/10.1080/0361073X.2014.897151>

Zebrowitz, L. A., Franklin, R. G., Boshyan, J., Luevano, V., Agrigoroaei, S., Milosavljevic, B., & Lachman, M. E. (2014). Older and younger adults' accuracy in discerning health and

competence in older and younger faces. *Psychology and Aging*, 29(3), 454–468.

<https://doi.org/10.1037/a0036255>

Zebrowitz, L. A., Boshyan, J., Ward, N., Gutchess, A., & Hadjikhani, N. (2017). The older adult positivity effect in evaluations of trustworthiness: Emotion regulation or cognitive capacity? *PLoS ONE*, 12(1). <https://doi.org/10.1371/journal.pone.0169823>

Appendix A

Questionnaire Assessing Attitudes Towards Older Adults

Adapted from Collova, Sutherland & Rhodes (2019)

- 1) I know lots of older adults
- 2) I work in a job where I interact with older adults
- 3) I interact with older adults during recreational periods (e.g., at home or in the community)
- 4) I interact with older adults on a daily basis
- 5) I find older adults pleasant to spend time with
- 6) Older adults annoy me (negatively scored)
- 7) I enjoy caring for older adults
- 8) I think I am good at interacting with older adults

Rating Scale:

1	2	3	4	5	6
Very Strongly Disagree					Very Strongly Agree

Appendix B
PCA Communalities

Communality values indicate the amount of variance for each variable that is explained by the principal components (Tabachnick & Fidell, 2013). In other words, it is the sum of squared loadings for each variable for all components. Communalities over .6 are considered acceptable.

Table B1
Communalities for initial YA PCA with no forced factors

	Extraction
Caring	0.900
Confident	0.811
Content	0.935
Energetic	0.870
Friendly	0.943
Fun	0.920
Genuine	0.871
Grumpy	0.949
Hardworking	0.842
Judgemental	0.873
Kind	0.931
Quiet	0.878
Stern	0.916
Suspicious	0.786
Wise	0.867

Table B2
Communalities for initial OA PCA with no forced factors

	Extraction
Active	0.835
Careful	0.747
Confident	0.813
Content	0.962
Determined	0.794
Friendly	0.934
Fun	0.948
Happy	0.928
Hardworking	0.703
Helpful	0.921
Honest	0.779
Intelligent	0.777
Interested	0.801
Kind	0.958
Lonely	0.897
Opinionated	0.882
Quiet	0.751
Stern	0.946

Appendix C

Pattern Matrices for Initial PCA Solutions

Table C1

YA pattern matrix from the initial solution based on eigenvalues > 1

	Component 1	Component 2	Component 3
Stern	-1.039	0.186	0.015
Judgemental	-1.029	0.141	0.229
Grumpy	-1.017	0.107	-0.02
Caring	0.941	0.038	-0.045
Kind	0.94	0.071	-0.046
Friendly	0.936	0.012	0.093
Genuine	0.935	0.056	-0.144
Content	0.919	-0.056	0.204
Fun	0.875	0.007	0.212
Suspicious	-0.847	-0.14	0.205
Hardworking	-0.287	1.036	-0.068
Wise	0.265	0.808	-0.185
Quiet	0.251	0.245	-0.973
Energetic	0.489	0.116	0.603
Confident	0.075	0.527	0.564

Note: coefficients over .4 are bolded

Table C2

OA pattern matrix from the initial solution based on eigenvalues > 1

	Component 1	Component 2	Component 3
Opinionated	-1.025	0.218	0.306
Stern	-0.996	0.156	-0.006
Kind	0.941	0.076	0.034
Determined	-0.924	0.372	0.264
Fun	0.864	-0.062	0.239
Honest	0.852	0.454	-0.366
Friendly	0.851	0.049	0.188
Content	0.84	0.023	0.242
Happy	0.825	-0.064	0.284
Helpful	0.699	0.221	0.268
Interested	0.594	0.296	0.246
Hardworking	0.066	1.025	-0.523
Intelligent	0.091	0.818	0.058
Careful	-0.084	0.809	0.118
Confident	-0.226	0.735	0.312
Quiet	-0.029	0.277	-0.986
Active	-0.087	0.271	0.763
Lonely	-0.476	-0.129	-0.553

Note: coefficients over .4 are bolded

Appendix D

PCA with Varimax Rotation

Table D1

Number of components to retain by each method using varimax rotation

	YA PCA	OA PCA
Kaiser's Criterion	3	3
Scree Test	1 or 2	2 or 3
Parallel Analysis	2	2

Table D2

Rotated component matrix for YA two-component solution using varimax rotation

	Component 1	Component 2
Grumpy	-0.941	-0.200
Kind	0.940	0.218
Judgemental	-0.929	0.047
Stern	-0.928	-0.130
Caring	0.927	0.201
Genuine	0.926	0.117
Friendly	0.915	0.313
Suspicious	-0.874	-0.086
Content	0.874	0.374
Fun	0.858	0.407
Wise	0.595	0.332
Confident	0.316	0.827
Energetic	0.544	0.737
Quiet	0.314	-0.709
Hardworking	0.160	0.434

Note: coefficients over .4 are bolded

Table D3

Rotated component matrix for OA two-component solution using varimax rotation

	Factor 1	Factor 2
Stern	-0.970	0.057
Kind	0.959	0.178
Fun	0.952	0.190
Content	0.941	0.270
Happy	0.933	0.218
Friendly	0.932	0.256
Opinionated	-0.856	0.340
Helpful	0.840	0.464
Determined	-0.753	0.464
Honest	0.747	0.234
Interested	0.736	0.510
Lonely	-0.729	-0.566
Confident	0.009	0.901
Careful	0.076	0.843
Intelligent	0.225	0.822
Active	0.280	0.805
Hardworking	-0.024	0.591
Quiet	-0.418	-0.460

Note: coefficients over .4 are bolded