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Facial expressions of authenticity: Emotion variability increases judgments of trustworthiness and leadership

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ABSTRACT

People automatically generate first impressions from others' faces, even with limited time and information. Most research on social face evaluation focuses on static morphological features that are embedded "in the face" (e.g., overall average of facial features, masculinity/femininity, cues related to positivity/negativity, etc.). Here, we offer the first investigation of how *variability* in facial emotion affects social evaluations. Participants evaluated targets that, over time, displayed either high-variability or low-variability distributions of positive (happy) and/or negative (angry/fearful/sad) facial expressions, despite the overall averages of those facial features always being the same across conditions. We found that high-variability led to consistently positive perceptions of authenticity, and thereby, judgments of perceived happiness, trustworthiness, leadership, and team-member desirability. We found these effects were based specifically in variability in emotional displays (not intensity of emotion), and specifically increased the positivity of social judgments (not their extremity). Overall, people do not merely average or summarize over facial expressions to arrive at a judgment, but instead also draw inferences from the variability of those expressions.

1. Introduction

From simple exposure to a face, a constellation of trait-judgments come to mind (Freeman & Johnson, 2016; Schiller, Freeman, Mitchell, Uleman, & Phelps, 2009; Todorov, Olivola, Dotsch, & Mende-Siedlecki, 2015), even from the briefest exposures (Bar, Neta, & Linz, 2006; Rule & Ambady, 2008a; Rule, Ambady, & Hallett, 2009; Todorov, Pakrashi, & Oosterhof, 2009; Willis & Todorov, 2006). Indeed, impressions of a particular person will change depending on the facial expression that person displays (Hehman, Flake, & Freeman, 2015; Oosterhof & Todorov, 2009; Todorov & Porter, 2014). Critically, first impressions from faces also have important social consequences, such as who we see, remember, judge, and treat as trustworthy (Oosterhof & Todorov, 2009; Rule, Slepian, & Ambady, 2012; Slepian & Ames, 2016; Winston, Strange, O'Doherty, & Dolan, 2002).

Recent developments in data-driven face modeling have helped illuminate the dimensions and mechanisms involved in rapid impression formation (Todorov et al., 2015). These methods usually involve generating and positioning faces in multidimensional space (varying facial appearance across a number of dimensions) to gauge the static facial features that are most important for first impressions (e.g., apparent positivity, dominance, etc.; Oosterhof & Todorov, 2008; Said & Todorov, 2011; Sutherland et al., 2013). Inherently, these models rely on the morphological features that are embedded "in the face" (e.g., overall average of morphological facial features, and which combinations make a person appear trustworthy, masculine, feminine, powerful, etc.). Noting similarities in these patterns helps to demonstrate which facial cues people associate with trait impressions. For instance, the more a neutral face contains features consistent with happiness, the more that face is judged as trustworthy-looking (Said, Sebe, & Todorov, 2009). Additionally, these models can help establish which traits are more embedded in the face, and which are more in the eyes of perceivers (see Hehman, Sutherland, Flake, & Slepian, 2017; Xie, Flake, & Hehman, 2018).

Yet, people's faces are far from static. They exist over time, with various expressions that unfold across seconds, minutes, hours, and days. This begs the question of how does the *variability* (or range) in a person's facial features over time influence social impression formation? In other words, is variability considered noise in the data over which an observer averages to arrive at a final impression? Or, do people draw inferences from variability itself to inform their social judgments? People are sensitive to variations across social targets (e.g., the extent to which a set of faces look to different from each other; Phillips, Slepian, & Hughes, 2018). Yet, we are only aware of one published study on facial variability within an individual. One recent paper found that exposure to variability (i.e., the same person

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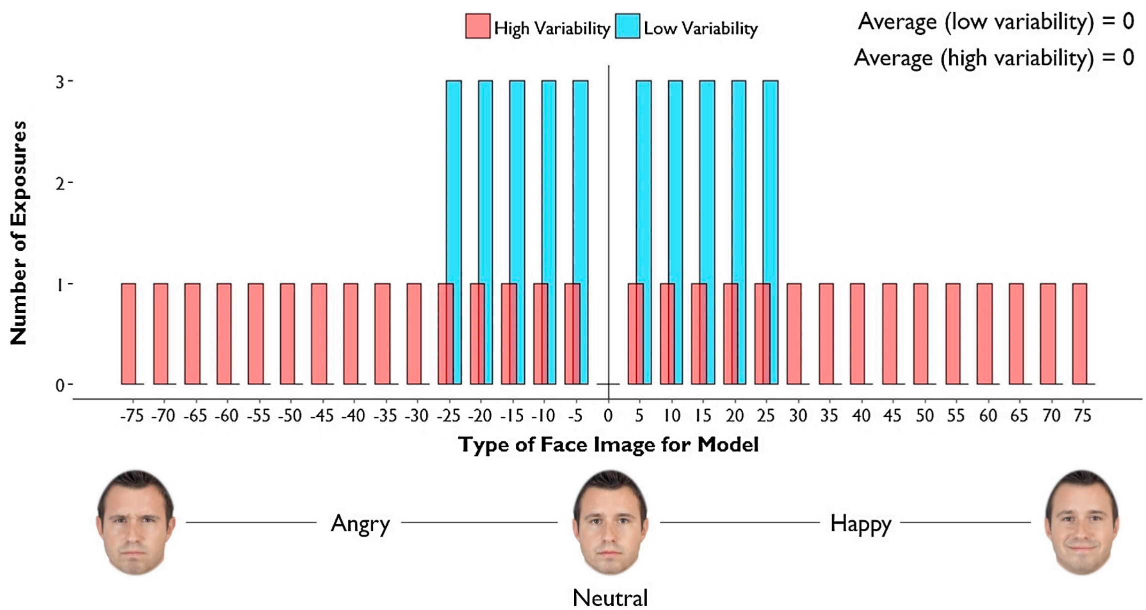

Fig. 1. Design of stimulus presentation for the high and low-variability conditions in Study 1. Participants were exposed to 30 sequential presentations of different face images from the same target (500-ms exposure + 100-ms ITI each), and this was repeated for six different White male targets (later studies add female targets). In the high-variability condition, the target displayed expressions ranging from 75% angry to 75% happy (in 5% increments). In the low-variability condition, the target displayed expressions ranging from 25% angry to 25% happy (in 5% increments). Participants saw 30 exposures per each target, and the overall average of happy/angry features was equal in both variability conditions (i.e., the overall average was at the neutral point for both high-variability and low-variability distributions).

displaying multiple emotions across different exposures) vs. stability (i.e., the same person displaying the same emotion across different exposures) led people to endorse the notion that people, in general, can change what they are like (Weisbuch, Grunberg, Slepian, & Ambady, 2016). However, the actual social judgments people make based on different levels of facial variability remain untested.

To investigate this question, we highlight two models of face evaluation: a *feature-extraction model* and a *social-inferential model*, which make competing predictions about how variability in facial expressions should influence social judgments. Before outlining these two models as they apply to facial variability, we first briefly contrast facial variability to *temporal facial dynamics.* Facial variability is the topic of the current investigation, where we examine how the display of *multiple expressions* across time (along with their various magnitudes) informs social judgments. Temporal facial dynamics, in contrast, is the study of how *a single expression* unfolds over a short time window (Ambadar, Schooler, & Cohn, 2005; Carr, Korb, Niedenthal, & Winkielman, 2014; Jack, Garrod, Yu, Caldara, & Schyns, 2012; Krumhuber et al., 2007). Research in temporal facial dynamics often compares judgments of a static expression photograph to watching a video display the onset of that emotional expression. Dynamic (vs. static) displays often improve decoding accuracy (e.g., Duchenne vs. non-Duchenne smiles; Krumhuber, Kappas, & Manstead, 2013; Krumhuber & Kappas, 2005). In contrast to this body of work, we examine how people make judgments of a person after seeing multiple exposures of that person displaying different expressions across images. That is, rather than examine the movement parameters of an expression, we examine the social judgments people make of a person who displays a *range* of emotional expressions.

The current work provides the first investigation of how *variability* in facial emotion influences impression formation. We demonstrate that greater variability in facial emotion leads people to believe that a person is more authentic (i.e., in genuinely displaying their "true" emotions; see Carr, Korb, et al., 2014; Liu & Perrewe, 2006; Wickham, 2013). We found that this effect extends to a variety of other social dimensions (e.g., perceived happiness, trustworthiness, and leadership potential).

1.1. Feature-extraction models of face evaluation

Data-driven models of face evaluation have become prominent in social and cognitive psychology, as a "bottom-up" method for studying first impressions (e.g., Todorov, Baron, & Oosterhof, 2008; Todorov, Dotsch, Porter, Oosterhof, & Falvello, 2013; Todorov, Dotsch, Wigboldus, & Said, 2011; Todorov, Said, Engell, & Oosterhof, 2008). The computational methods implemented in these studies can account for a high degree of variance (over 60%) in first impressions across many complex social dimensions (e.g., attractiveness, trustworthiness, threat, etc.; Said & Todorov, 2011; Todorov et al., 2013; Todorov, Said, et al., 2008). This work has shown that morphological features are a key driver of face evaluation. For example, Oosterhof and Todorov (2008) demonstrated that evaluative judgments are largely driven by the face's perceived valence and dominance (see also Sutherland et al., 2013).

Note, however, that such methods rely on *single* snapshots of faces, or *single* brief videos of faces (e.g., displaying the onset of a smile) and the impressions they elicit are solely dependent on the features that are embedded "in the face" (e.g., amount of smiling, masculinity, skin tone, etc.). Thus, any evaluation of the face relies on some rapid perceptual extraction of these morphological expression cues, and summarizing over these features to arrive at a final judgment—what we term *feature-extraction models.* When viewing a face, the perceiver summarizes (or averages) over all facial features, and this summary (average) is the basis for their impression. Such processes align with ensemble-coding frameworks (e.g., Alvarez, 2011), whereby exposure to a set of exemplars (presented simultaneously) leads to an overall representation of the *average* expression across exemplars. When observing sets of faces that varied in emotionality, participants retained little information about the emotion of any individual face, but they extracted representations of the mean emotion (Haberman & Whitney, 2007, 2009). Similar findings have also been reported for basic perception of colored circles (Brady & Alvarez, 2011) to more complex aspects of group perception (e.g., crowd gaze, gender, or dynamic motion; Alt, Goodale, Lick, & Johnson, 2017; Elias, Dyer, & Sweeny, 2017; Goodale, Alt, Lick,

& Johnson, 2018; Haberman & Whitney, 2007; Sweeny, Haroz, & Whitney, 2013; Sweeny & Whitney, 2014).

But what happens if one is presented, not with a single presentation of an individual, but rather with a sequence of photographs of the same person with emotional expressions that change over time? Here, one would not only have the static morphological features of the person's face to consider (e.g., their masculinity, facial width, eye color, skin tone, etc.), but are also the *variability* across time (or range in the magnitude and shape of their emotional facial features). Fig. 1 shows a general schematic for this idea.

Imagine seeing a person on their phone displaying a range of expressions. For instance, they could be displaying a wide range of expressions that vary between anger and happiness (i.e., *high*-variability), or their expressions may vary within a tighter range around a neutral expression (i.e., *low*-variability). We capture this difference between low- and high-variability in our studies by creating different continua of expressions ranging from one emotion to another, passing through a neutral expression at the midpoint. With such a design applied to the current example (ranging from anger to happiness, but with low- or high-variability), in both cases, the average summary representation would be that person's neutral expression (which our stimuli and designs ensure is the morphological mean). Feature-extraction models that summarize over multiple cues would create a summary representation to inform one's judgment (thus, averaging over the variability). Therefore, any variability around the objective feature average would simply be noise over which people would summarize to arrive at a final judgment.

1.2. A social-inferential model

Above and beyond an average summary representation from feature extraction, a *social-inferential model* would consider facial emotion variability itself to be socially informative. Specifically, we propose that a social-inferential model would integrate the meaning behind how facial features vary over time with a summary representation. This integration would arrive at a nuanced first impression that considers both aspects: the average *and* variability.

There are many reasons for why variability in facial emotion would be socially meaningful. First, people are sensitive to variance across different individuals (Phillips et al., 2018), and thus they might also be sensitive to variance with an individual. Second, people are likely to infer social qualities from the range of emotions a target expresses. The degree to which people successfully regulate expressed emotions influences not only the expression of those emotions, but the quality of one's social interactions with others (Gross, 2002; Lopes, Salovey, Côté, & Beers, 2005; Ochsner & Gross, 2005; Zaki & Williams, 2013), with long-term implications for health and well-being (Gruber, Kogan, Quoidbach, & Mauss, 2013; Oosterwegel, Field, Hart, & Anderson, 2001). These studies suggest that the social-contextual meanings behind facial expressions (and the target displaying them) will influence social judgments. Also, as briefly mentioned earlier, facial variability has been linked with the notion that people can change (Weisbuch et al., 2016), but this prior work did not specifically examine how people judge the person with the changing expression. These findings point to a potential link between facial emotion variability and impression formation, the possibilities for which we elaborate on next.

1.3. The link between facial emotion variability and first impressions

In the current studies, we presented participants with targets that displayed different levels of facial emotion variability (high vs. low) between different emotions. In Studies 1, 2, 3a, 3b, and 4, we controlled for the overall average of emotional features between variability conditions. In other words, in these studies, the mean (average) of both morphological distributions was the same, but the variability ("spread") of the distributions was manipulated. These studies tested whether variability (i.e., changes in the range or magnitude of emotional facial features) influence rapid impression formation, beyond the average features themselves (i.e., overall amount of smiling or frowning). In Study 5, we held constant both the overall average of emotional intensity and valence, but manipulated the number of distinct emotions displayed. In all studies, we examined whether high (vs. low) variability led to more favorable social impressions.

Feature-extraction models would predict that participants will summarize over all exposures to someone's face (regardless of how their emotional facial features vary across exposures). Thus, any emotional feature variability would be noise to be averaged over. In Studies 1–4, the overall average of facial features was the same across our variability conditions (while only manipulating variability). In Study 5, the overall average intensity and valence was the same across our variability conditions (while only manipulating variability of unique emotional displays). In both cases, a feature-extraction only model would predict no difference in social impressions between high- and low-variability conditions (given that in both distributions, the summary representation would be equal in morphology/valence and intensity/valence, respectively).

A social-inferential model, in contrast, would predict variability itself to be used as a cue for social judgments. Research demonstrates that authenticity and "readability" of emotional expressions is especially important for social judgments (Carr, Korb, et al., 2014; Wickham, 2013; Winkielman, Olszanowski, & Gola, 2015). If someone has a greater range or variability in their emotional expressions, they might appear to be authentically displaying their "true" emotions, which would lead to more positive impressions on related dimensions (e.g., perceived happiness, trustworthiness, and/or leadership; see Krumhuber et al., 2007; Wang, Sui, Luthans, Wang, & Wu, 2014). Given that facial variability is also connected to the idea that people can change (Weisbuch et al., 2016), such variability may also indicate that the individual has the emotional capacity to effectively adapt their affective states to different social contexts. In sum, a narrow range of emotional displays may be taken as signal that one is not adapting to their environment or authentically expressing themselves. In contrast, expressing emotional variability may suggest one is engaging in the environment in a healthy way and authentically. A social-inferential model would thus suggest that in addition to a summary representation from feature extraction, social inferences would be made from variability around the mean.

1.4. Current studies

We offer the first investigation of how *variability* in facial emotion influences social evaluations: Participants evaluated targets that, over time, displayed either high-variability or low-variability distributions of positive (happy) and/or negative (angry, fearful, sad) facial expressions, despite overall averages of those facial features always being the same. We find that greater variability in facial emotion led to more positive social impressions (on dimensions like happiness, trustworthiness, and leadership potential; Studies 1, 2, 3a, and 3b), and this was driven by increases in perceived authenticity (Study 3b). Furthermore, variability in emotional displays was associated with more favorable impressions (rather than more extreme social judgments; Study 4). And finally, we found that these effects were based specifically in variability in emotional displays (not intensity of emotion; Study 5). For all studies, we did not allow participants to participate in more than one study (based on their worker ID and IP address). Overall, these results support a social-inferential model of face evaluation, whereby people do not merely average over facial expressions to arrive at a judgment, but instead draw inferences from the variability of those expressions.

2. Study 1

In Study 1, we tested our main question: Does *variability* in facial emotion influence impression formation, while controlling for the overall average of those facial features? To examine this question, participants were exposed to a series of targets displaying either high-variability (wider range) or low-variability (smaller range) distributions of positive (happy) and/or negative (angry) facial expressions (see Fig. 1). We tightly controlled the magnitude of emotional features in the stimuli (using facial morphing techniques), along with the timing of stimulus presentation (using well-validated experiment software).

Focal variables: authenticity and happiness. Our primary dimension of interest was *authenticity*, given that both authentic expression and perceptions of authenticity are highly related to how people express their emotions (Grandey, Fisk, Mattila, Jansen, & Sideman, 2005; Korb, With, Niedenthal, Kaiser, & Grandjean, 2014; Niedenthal, Mermillod, Maringer, & Hess, 2010; Rychlowska, et al., 2014). Indeed people are sensitive to subtle facial indicators of authenticity (Carr, Korb, et al., 2014; Ekman, 1992; Shiota, Campos, & Keltner, 2003). We predicted that high-variability targets would be judged as more authentic than low-variability targets (i.e., perceivers would see the former as *not* holding back their "true" emotions). This makes the novel (and somewhat counterintuitive) prediction that high-variability targets will be evaluated more favorably even when they display more negative expressions than low-variability targets (see Fig. 1).

We also examine how authenticity-related effects from variability would relate to other social judgments. For instance, we included ratings of perceived *happiness* given that authenticity is closely linked to perceptions of happiness and overall well-being (Ménard & Brunet, 2011; Sariçam, 2015). Note that even though happiness expressions usually involve the vivid display of a smile (Becker & Srinivasan, 2014), the basic perception of an expression as "happy" is actually quite flexible (Barrett, Mesquita, & Gendron, 2011; Carr, Brady, & Winkielman, 2017).

Exploratory variables: power and trustworthiness. We also measured evaluations of the targets' social *power* (or how much perceived control they have over others' resources; Galinsky, Gruenfeld, & Magee, 2003), given that power is not only linked to felt and perceived authenticity (Kifer, Heller, Perunovic, & Galinsky, 2013), but it also affects how people regulate their emotions (van Kleef et al., 2008). Finally, we also included ratings of *trustworthiness*, since trust is often a downstream consequence of increases in perceived authenticity (e.g., Winkielman et al., 2015), and trustworthiness is highly influential in models of face evaluation (Oosterhof & Todorov, 2008). However, both power and trustworthiness incorporate a variety of other social aspects beyond emotional expressions (see Anderson, John, Keltner, & Kring, 2001; Keltner, Gruenfeld, & Anderson, 2003; Smith & Magee, 2015; Wilson & Rule, 2017), and thus the inclusion of these dimensions was more exploratory.

2.1. Methods

2.1.1. Participants

We recruited 150 participants on Amazon Mechanical Turk, wherein 152 completed the study (M_{age} = 36.61 years, SD_{age} = 11.99 years; 44% female).[1] Our experimental procedures were approved by the Columbia University Human Research Protection Office under the Institutional Review Board. All participants were located in the U.S. (verified by IP address) and given monetary compensation for their participation. These standards were applied to all studies in this paper (each of which used participants from Mechanical Turk).

Note that previous research has shown that Mechanical Turk participants are not only significantly more diverse than typical samples of college undergraduates (frequently used in traditional lab studies; Buhrmester, Kwang, & Gosling, 2011; Casler, Bickel, & Hackett, 2013), and provide data of equivalent quality to that provided by in-lab participants (Buhrmester et al., 2011; Casler et al., 2013; Hauser & Schwarz, 2016). Therefore, our results should generalize more broadly than traditional lab samples of college undergraduates.

2.1.2. Materials

We created our facial stimuli using still images from the Chicago Face Database (CFD; Ma, Correll, & Wittenbrink, 2015). From the CFD, in Study 1, we selected 6 different White male targets to use for morphing (but note that other emotions were morphed in Study 5, and additional female targets were used in Studies 3a, 3b, 4 and 5). Using 100%-angry, 100%-happy, and neutral images for each target, we generated a morph continuum that spanned 41 different levels: 100% angry through neutral to 100% happy, in 5% increments. Note that all the stimuli were single-person morphs; that is, images of different individuals were never blended together. All the faces were then cropped so that only the facial features were visible. With these images, we could present highly controlled distributions of facial expressions to participants.

In our studies, we used consecutive image presentations (instead of videos) for two main reasons. First, our predictions required tight control over the exact magnitude of emotional features in each facial image (which also depends on their timing), and this is much more difficult to control with naturalistic videos. Second, previous work has shown that dynamic (as opposed to static) facial features can influence social impressions (e.g., Ambadar, Schooler, & Cohn, 2005; Carr, Korb, et al., 2014, Carr, Winkielman, et al., 2014; Krumhuber et al., 2007; Krumhuber et al., 2013; Krumhuber & Kappas, 2005). Our main question here was *not* about whether the face was moving (dynamic vs. static). Rather, we were interested in how the variability (or range and distribution) of facial features across different presentations influences rapid impression formation, above and beyond the average of those features (e.g., overall amount of frowning or smiling). In turn, our image presentation paradigm not only allows for precision in testing our main question, but it also controls for the overall amount of dynamicity between high- and low-variability conditions (i.e., the face images updated with equal frequency in both conditions; the only difference was the variability of the facial features displayed across images).

2.1.3. Software

To administer our study to participants in an online environment, we used Inquisit Web 5.0 (http://www.millisecond.com/). Inquisit Web offers highly reliable timing over the web by having participants first download an Inquisit 5.0 Player app locally to their machine, where it has access to the high-performance native system components required for millisecond precision timing (similar to traditional lab studies). This engine has also been tested in several different environments for compatibility across a wide variety of browsers and platforms.

2.1.4. Design

Participants were provided with a cover story. They were told that we conducted interviews with people about their daily lives, and would be presenting multiple snapshots of facial expressions captured during those interviews. Participants were then exposed to 30 facial images per each of six targets in different blocks (randomly ordered). Three targets were randomly assigned to high-variability, and the other three targets were randomly assigned to low-variability (target assignments to variability conditions was counterbalanced across participants).

Variability was thus a within-subject manipulation, so participants saw both high- and low-variability targets during their session. High-variability targets displayed facial expressions ranging from 75% anger

[1] When a participant does not submit their payment code (but completes the study), an additional participant is able to participate. We analyzed all participants' data who completed the study.

to 75% happiness (in 5% increments), and low-variability targets displayed facial expressions ranging from 25% anger to 25% happiness (in 5% increments). Critically, note that the overall average of both the high- and low-variability distributions equals zero (the neutral expression), so the only difference between the distributions is the variability of facial features that are displayed across images (see Fig. 1 presented earlier).

2.1.5. Procedure

At the start of each target block, participants were told that "a set of photos for one of the individuals will be displayed after you advance from this screen. Watch closely, since you will be asked for ratings afterwards!" Per each target, they were exposed to 30 consecutive face images (randomly ordered), each presented for 500-ms with a 100-ms ITI. After the images, participants gave overall ratings (randomly ordered) of each target on how authentic, happy, powerful, and trustworthy they seemed (using 100-point sliders; 0 = *not at all*, 100 = *very much*).

Supplemental material. All data and analysis scripts are available for download at https://osf.io/62cqj/.

2.2. Results

2.2.1. Analysis strategy

We analyzed our repeated-measures data using multilevel models (MLMs), which account for random variance from participants and stimuli (Judd, Westfall, & Kenny, 2012). We used Type III Satterthwaite approximations to estimate degrees of freedom to calculate *p*-values (Luke, 2016), via the *lmerTest* package in R (Kuznetsova, Brockhoff, & Christensen, 2016). All MLMs included random-intercepts for subject IDs and target IDs, allowing for model convergence after 10,000 iterations (West, Welch, & Galecki, 2014). Accordingly, any relationships between our fixed-effect of interest (i.e., variability; low vs. high) and impression formation variables are not attributable to any specific participant or target face, and thus conceptually generalize to both unsampled participants and faces.

2.2.2. Social impressions

High-variability targets were rated as more authentic ($b = 3.62$, 95% confidence interval for b [CI_{95}] = [1.15, 6.08], $t(755.20) = 2.88$, $p = .004$, $d_Z = 0.23$), happier ($b = 6.51$, CI_{95} = [4.19, 8.83], $t(754.50) = 5.51$, $p < .001$, $d_Z = 0.45$), and more trustworthy ($b = 3.18$, CI_{95} = [0.82, 5.54], $t(754.50) = 2.65$, $p = .008$, $d_Z = 0.21$) than low-variability targets. However, we did not observe any difference in ratings for power ($b = 0.48$, 95% CI [−1.68, 2.64], $t(754.50) = 0.44$, $p = .66$, $d_Z = 0.04$; see Fig. 2).

3. Study 2

Study 1 demonstrated that consistent with our central prediction, high-variability led to more positive perceptions of authenticity. This even extended to emotion-perception, whereby high-variability targets also looked happier than low-variability targets, despite displaying more intense negative facial features (see Fig. 1). Collectively, this also made high-variability targets appear more trustworthy.

We propose that authenticity is the most proximal dimension to cause positive benefits from high-variability, given that authentic people indeed are seen as more happy and trustworthy. Without such a mechanism, it would make little sense to see people who display more extreme *negative* emotions as happier and more trustworthy (which is characteristic of the high-variability condition; see Fig. 1). We collected data on trustworthiness and power for exploratory reasons, but the data provide nuance to understanding the influence of variability in emotion displays. Variability did not seem to influence impressions of power, which suggests that our results were not a function of a mere "halo effect" for high-variability targets.

Study 2 was designed to answer our next follow-up question: Does the variability need to involve a mix of positive and negative expressions (*both* happy and angry), or is it sufficient for variability to occur with only negative expressions (*only* angry), or only positive expressions (*only* happy)?

In Study 2, in addition to the conditions used in Study 1 (i.e., variability around a neutral expression, displaying both positive and negative emotions), we added targets that displayed high- or low-variability in only positive expressions (i.e., variability around 50% happy) and only negative expressions (i.e., variability around 50% angry). Fig. 3 shows a schematic for this new design. We term the averages around which targets' expressions varied as different *baselines*—where the baseline could be negative (50% angry), neutral (neutral expression), or positive (50% happy).

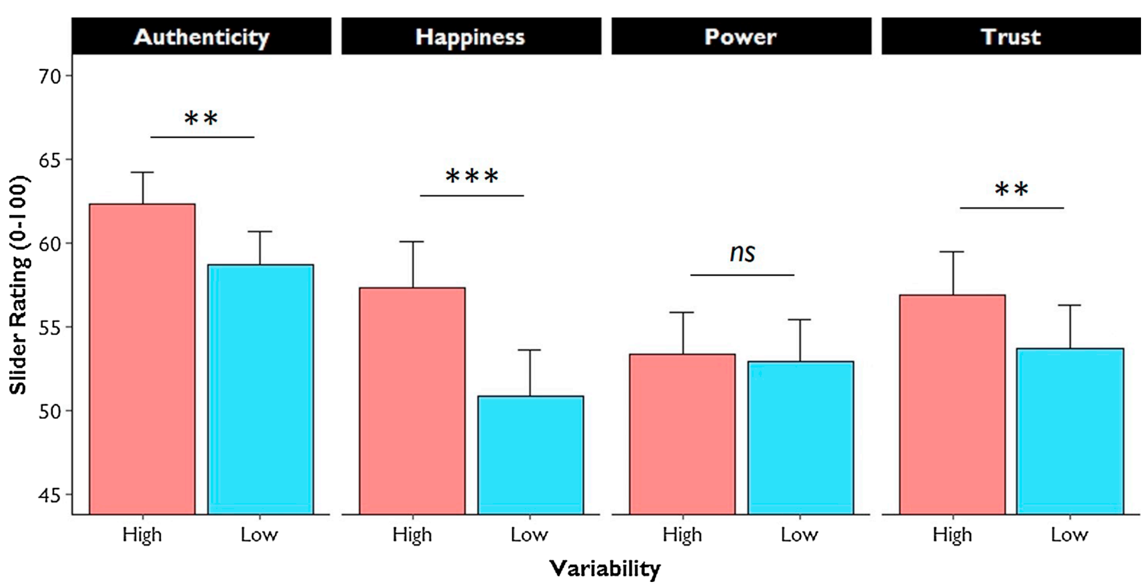

Fig. 2. Main results for Study 1. Error bars = ± 1 SEM. $^{***}p \leq 0.001$, $^{**}p \leq 0.01$, *ns* = not significant.

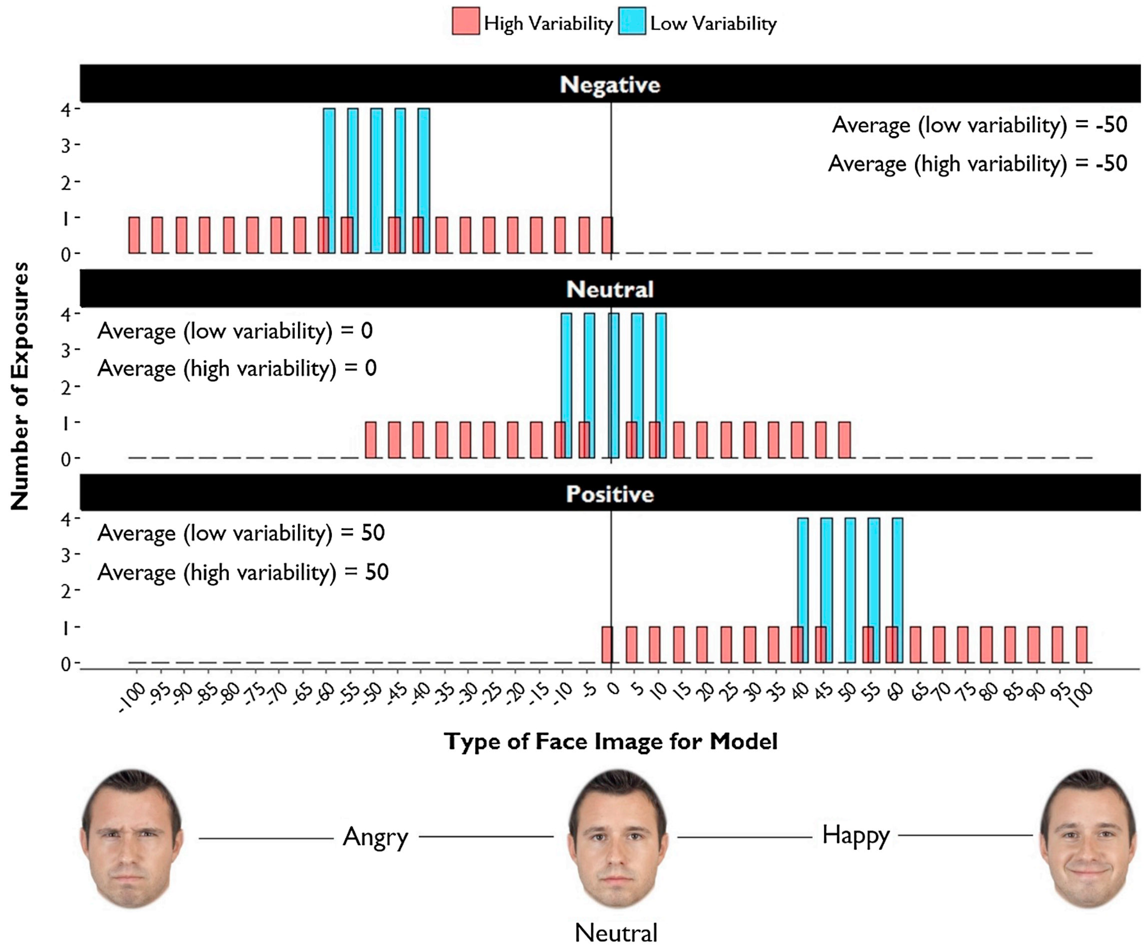

Fig. 3. Design of stimulus presentation in the high- and low-variability conditions for negative, neutral, and positive baselines in Studies 2, 3a, and 3b. In Studies 2, 3a, and 3b, to avoid overlap in expressions between baseline conditions, participants saw 20 face images per target (rather 30 per target, as in Study 1), which also ensured the average at each baseline was equal across high and low-variability conditions. Like Study 1, each face image was displayed for 500-ms (100-ms ITI). Within the negative baseline condition, the high-variability target displayed expressions ranging from 100% angry to neutral (in 5% increments), whereas the low-variability target displayed expressions ranging from 60% angry to 40% angry (in 5% increments). Within the neutral baseline condition, the high-variability target displayed expressions ranging from 50% angry to 50% happy (in 5% increments), whereas the low-variability target displayed expressions ranging from 10% angry to 10% happy (in 5% increments). Within the positive baseline condition, the high-variability target displayed expressions ranging from neutral to 100% happy (in 5% increments), whereas the low-variability target displayed expressions ranging from 40% happy to 60% happy (in 5% increments). For each baseline condition, the number of exposures for each expression was titrated so that the overall average of happy/angry features was equal between the high and low-variability conditions (the overall average was 50% angry for the negative baseline, 0 [or neutral] for the neutral baseline, and 50% happy for the positive baseline).

3.1. Method

3.1.1. Participants

Due to added conditions in Study 2, we recruited 200 participants on Mechanical Turk, and 202 (see footnote 1) completed the study (M_{age} = 39.90 years, SD_{age} = 12.31 years; 53% female).

3.1.2. Materials and software

We used the same face stimuli (angry-to-happy morph continuum) and software (Inquisit Web 5.0; http://www.millisecond.com/) as in Study 1, but changed the facial expression distributions that were displayed (see below, and Fig. 3).

3.1.3. Design and procedure

We used the same procedure as in Study 1, but with the additional baseline conditions added within-subjects. Fig. 3 shows the six different facial expression distributions that participants were exposed to in one session. Each of the six targets was randomly assigned to be (i) either high- or low-variability, and their facial expressions could (ii) vary around a positive, neutral, or negative baseline (random assignment of targets to variability and baseline valence conditions was counterbalanced across participants). Like Study 1, each face image was displayed for 500-ms (100-ms ITI). Specifically, for each baseline condition, the number of exposures for each expression was titrated so that the overall average of happy/angry features was equal between the high and low-variability conditions.

3.1.3.1. Baseline conditions. Specifically, (1) for the *negative* baseline condition, the overall average was 50% angry [(1a) high-variability targets displayed expressions ranging from 100% angry to neutral (in 5% increments); (1b) low-variability targets displayed expressions ranging from 60% angry to 40% angry (in 5% increments)].

Next, (2) for the *positive* baseline condition, the overall average was 50% happy [(2a) high-variability targets displayed expressions ranging from 100% happy to neutral (in 5% increments); (2b) low-variability targets displayed expressions ranging from 60% happy to 40% happy (in 5% increments)].

Finally, (3) for the *neutral* baseline condition, the overall average was 0% angry/0% happy; that is, neutral as in Study 1 [(3a) high-variability targets displayed expressions ranging from 50% angry to 50% happy (in 5% increments); (3b) low-variability targets displayed expressions ranging from 10% angry to 10% happy (in 5%

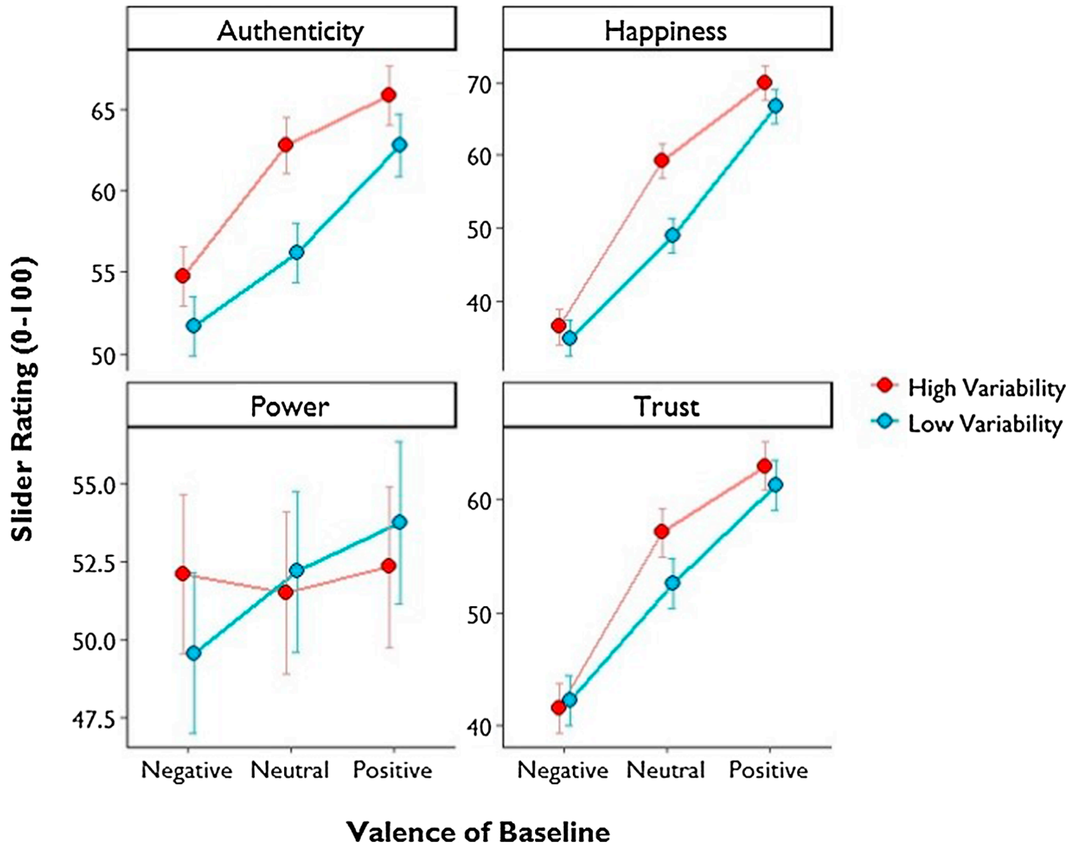

Fig. 4. Main results for Study 2. Error bars = ± 1 SEM.

increments)].

To avoid overlap in expressions between baseline conditions, participants saw 20 face images per target (rather 30 per target, as in Study 1), which also ensured the average at each baseline was equal across high and low-variability conditions.

3.1.3.2. Ratings. As in Study 1, after each target's sequence of expressions, participants rated the target on (randomly ordered) authenticity, happiness, power, and trustworthiness (using 100-point sliders; 0 = *not at all*, 100 = *very much*).

Supplemental material. All data and analysis scripts are available for download at https://osf.io/62cqj/.

3.2. Results

3.2.1. Analysis strategy

We used a similar MLM analysis strategy as in Study 1. In Study 2, we generated MLMs on each rating dimension, according to a Baseline Valence (3 [within-subjects]: positive, neutral, negative) × Variability (2 [within-subjects]: high, low) fixed-effects structure.

3.2.2. Social impressions

Fig. 4 displays all findings.

3.2.2.1. Authenticity. On the authenticity dimension, we observed main effects for Baseline Valence, $F(2, 1002.30) = 33.33$, $p < .001$, and Variability, $F(1, 1002.90) = 14.42$, $p < .001$.

The Baseline Valence main effect showed that participants found targets varying around the positive baseline (50% happy) to appear more authentic than those at the neutral baseline (0% happy/0% angry) and negative baseline (50% angry).

The Variability main effect replicated the authenticity results from Study 1, whereby high-variability targets were rated as more authentic than low-variability targets (when collapsing across baselines). However, this Variability main effect was mostly driven by the neutral baseline condition (high-variability targets were deemed more authentic than low-variability targets when varying around the neutral point; $b = 6.63$, $CI_{95} = [2.83, 10.42]$, $t(1001.60) = 3.43$, $p < .001$, $d_Z = 0.24$), but not across the positive baseline ($b = 3.05$, $CI_{95} = [-0.74, 6.85]$, $t(1002.00) = 1.58$, $p = .12$, $d_Z = 0.11$) or negative baseline ($b = 3.06$, $CI_{95} = [-0.73, 6.85]$, $t(1001.00) = 1.58$, $p = .11$, $d_Z = 0.11$). Note, however, that the Baseline Valence × Variability interaction was not significant, $F(2, 1000.80) = 1.14$, $p = .32$.

3.2.2.2. Happiness. With happiness ratings, all effects were significant.

The Baseline Valence main effect, $F(2, 1000.7) = 343.17$, $p < .001$, showed unsurprisingly that participants judged targets varying around the positive baseline (50% happy) to appear happier than those at the neutral baseline (0% happy/0% angry) and negative baseline (50% angry).

Like Study 1, the Variability main effect, $F(1, 1000.90) = 24.17$, $p < .001$, demonstrated that participants thought high-variability targets looked happier than low-variability targets (when collapsing across baselines).

Finally, a Baseline Valence × Variability interaction, $F(2, 1000.20) = 6.65$, $p = .001$, revealed that the largest variability effects occurred around the neutral baseline: High-variability targets appeared happier than low-variability targets when the expressions varied around neutral ($b = 10.21$, $CI_{95} = [6.73, 13.68]$, $t(1000.50) = 5.77$, $p < .001$, $d_Z = 0.41$), but not around the negative baseline ($b = 1.62$, $CI_{95} = [-1.86, 5.09]$, $t(1000.30) = 0.91$, $p = .36$, $d_Z = 0.06$) and only marginally so around the positive baseline ($b = 3.28$, $CI_{95} = [-0.19, 6.76]$, $t(1000.60) = 1.85$, $p = .06$, $d_Z = 0.13$).

3.2.2.3. Power. Similar to Study 1, we found no effects on the power dimension. Each effect for power was non-significant: Baseline Valence main effect, $F(2, 1000.60) = 1.59$, $p = .21$, Variability main effect, $F(1, 1000.80) = 0.02$, $p = .88$, and Baseline Valence × Variability interaction, $F(2, 1000.20) = 1.46$, $p = .23$.

3.2.2.4. Trust. For the trust dimension, the pattern of results looked similar to authenticity and happiness, but the effects were weaker.

We observed a main effect of Baseline Valence, $F(2, 1001.10) = 129.79$, $p < .001$, which showed that participants deemed targets that varied around the positive baseline (50% happy) to be more trustworthy than those that varied around the neutral baseline (0% happy/0% angry) or negative baseline (50% angry).

The Variability main effect was marginal, $F(1, 1001.40) = 3.08$, $p = .08$, and demonstrated that participants found high-variability targets to be more trustworthy than low-variability targets (when collapsing across baselines). Similar to authenticity and happiness, variability only seemed to have an impact on trust when the expressions varied around the neutral baseline: High-variability targets were rated more trustworthy than low-variability targets when the expressions varied around the neutral baseline ($b = 4.55$, $CI_{95} = [1.01, 8.10]$, $t(1000.80) = 2.52$, $p = .01$, $d_Z = 0.18$), but not around the negative baseline ($b = -0.72$, $CI_{95} = [-4.26, 2.83]$, $t(1000.50) = -0.40$, $p = .69$, $d_Z = 0.03$) nor around the positive baseline ($b = 1.67$, $CI_{95} = [-1.88, 5.22]$, $t(1001.00) = 0.93$, $p = .35$, $d_Z = 0.07$). Note, however, that this Baseline Valence × Variability interaction was not significant, $F(2, 1000.40) = 2.14$, $p = .12$.

4. Studies 3a and 3b

Studies 1 and 2 demonstrated that high-variability (compared to low-variability) in positive (happy) and negative (angry) expressions makes one appear more authentic. This leads to the novel (and somewhat counterintuitive) effect where high-variability targets also look happier than low-variability targets, despite displaying more intense negative facial features (see Figs. 1 and 3). Variability also seemed to similarly affect judgments of trustworthiness, albeit the effects on this dimension are weaker (we return to why this might be the case in the *General Discussion*).

Interestingly, these variability effects seemed to depend on a mix of positive and negative features (variability around a neutral baseline). Note that these effects cannot be explained by the dynamicity of the stimuli (i.e., images in the high- and low-variability conditions updated with equal frequency). These effects also cannot be explained by the specific targets that displayed the expressions (i.e., targets were randomized and counterbalanced to the variability conditions in all studies). It does not seem that perceivers are only averaging over the variability in the repeated presentations, as would be predicted by a strict feature-extraction model of face evaluation. These data thus far are more consistent with a social-inferential model of face evaluation, where variability in-and-of-itself is a contextually-sensitive cue for social judgment. Displaying a larger range of positive *and* negative emotions was evaluated favorably.

Studies 3a and 3b were designed to address two additional questions: (1) What are the mechanisms underlying the relationship between variability and social impressions, and (2) do these effects extend to important real-world dimensions for social decision-making, like leadership potential? That is, if people use variability in emotion expression to inform one's impression of that person, this should extend to even more interpersonal judgments (e.g., how effectively that person manages and interacts with other people). With respect to more interpersonal judgments, we were especially interested in gauging variability effects on perceptions of leadership, given that it is widely studied in social psychology (Chemers, 2001), cognitive science (Wofford, Goodwin, & Whittington, 1998), and applied cognition research (Howell & Avolio, 1993), particularly in how people respond to static faces (Olivola & Todorov, 2010; Olivola, Sussman, Tsetsos, Kang, & Todorov, 2012; Re & Rule, 2016; Rule & Ambady, 2008b, 2011b; Thora & Rule, 2017). Therefore, it is likely that variability in facial emotion may be an important cue that people use to judge others' aptitude in professional contexts.

To this end, we also measured another professional evaluation, the extent to which the target would make for a desirable team member. We predicted that authenticity would mediate the influence of variability (high vs. low) on ratings of leadership and team-membership desirability, especially given a mix of positive and negative emotions (neutral baseline, per the findings from Study 2). This not only follows from the findings in Studies 1–2, but emotion "readability" increases social interaction quality (Wickham, 2013), and authenticity is important for impression formation in professional contexts, with substantial downstream consequences for work satisfaction and productivity (Gardner, Avolio, Luthans, May, & Walumbwa, 2005; Hinojosa, Davis McCauley, Randolph-Seng, & Gardner, 2014; Ilies, Morgeson, & Nahrgang, 2005).

4.1. Method

4.1.1. Participants

We recruited 200 participants in Study 3a ($M_{age} = 39.85$ years, $SD_{age} = 12.66$ years; 58% female), and 300 participants (to account for more study cells) in Study 3b ($M_{age} = 36.25$ years, $SD_{age} = 10.94$ years; 58% female) on Amazon Mechanical Turk (199 participants completed Study 3a; 309 participants completed Study 3b; see footnote 1).

4.1.2. Materials and software

We used the same face stimuli (angry-to-happy morph continuum) and software (Inquisit Web 5.0; http://www.millisecond.com/) as in Study 2, but we also added six White female targets from the CFD (along with the six White male targets used in the prior studies), for a new total of 12 targets. We did this to ensure that our effects extended to facial emotions from both genders. All other changes in Studies 3a and 3b only involved minor modifications to the design and procedure to test our new hypotheses (see below).

4.1.3. Design and procedure

Studies 3a and 3b were very similar to Study 2, except for three main changes. First, to gauge how variability effects might extend to real-world social dimensions in the workplace, we also had participants in Studies 3a and 3b rate each target on leadership ("How good of a leader do you think this person would be?) and the target's desirability as a team-member ("How likely would you be to pick this person to work on a project with you at your job?), in addition to the dimensions from the previous studies (i.e., authenticity, happiness, power, and trust), all using 100-point sliders (0 = *not at all*; 100 = *very much*).

Second, to accommodate the addition of leadership ratings, we slightly modified our cover story, wherein the images were described as having been extracted from video interviews about the targets' professional lives and work-related projects.

Third, while Study 3a had the same within-subjects design as in Study 2 (all participants gave ratings on all dimensions), Study 3b had *four between-subject conditions* depending on the rating dimension (thus leading us to collect a larger sample in that study). This Study 3b design allowed us to conduct multilevel mediation analyses to isolate the dimension(s) most important for impressions of targets in a professional context (and ensure that our mediation effects were not contaminated by inflated cross-correlations across rating dimensions). In addition to rating leadership and team-member desirability in Study 3b, participants were randomly assigned to also either rate authenticity ($n_1 = 89$), happiness ($n_2 = 77$), power, ($n_3 = 78$), or trust ($n_4 = 65$).

Supplemental material. All data and analysis scripts are available for download at https://osf.io/62cqj/.

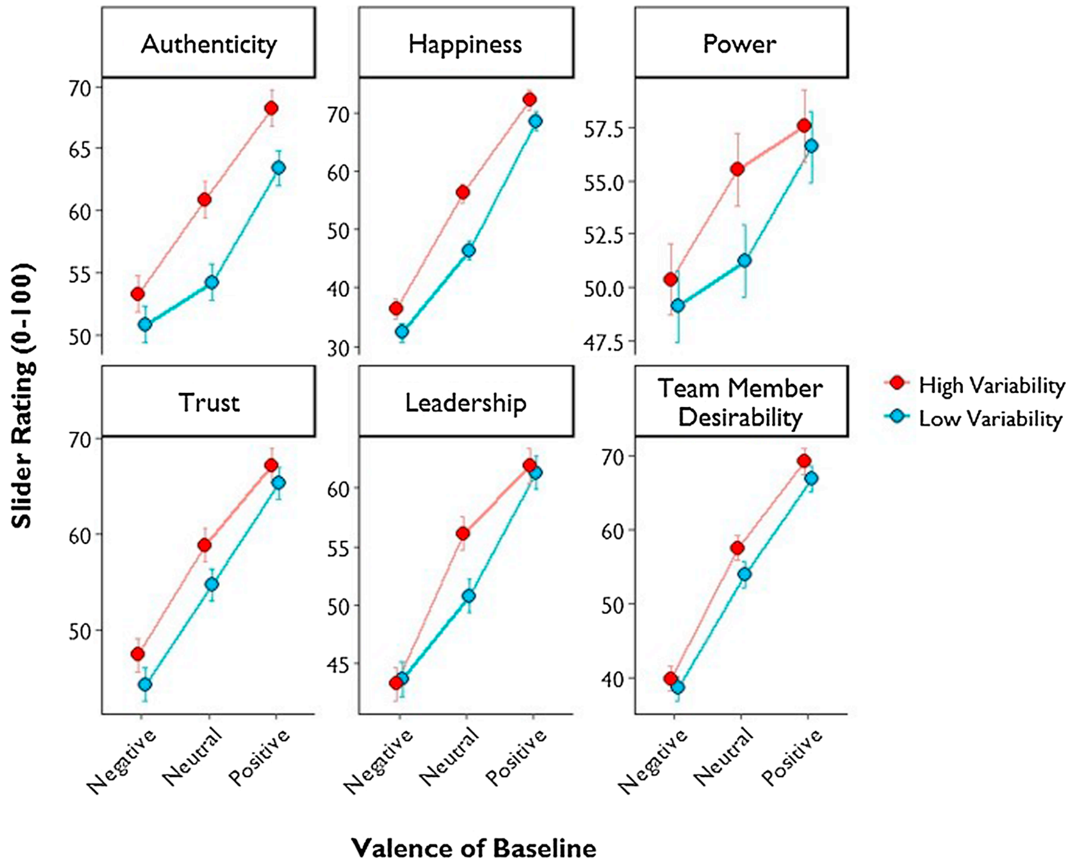

Fig. 5. Main results for Studies 3a and 3b. Error bars = ± 1 SEM.

4.2. Results

4.2.1. Analysis strategy

We used a similar MLM analysis strategy as in Study 2. In Studies 3a and 3b, we combined the rating data and generated meta-analytic MLMs on each rating dimension, according to a Baseline Valence (3 [within-subjects]: positive, neutral, negative) × Variability (2 [within-subjects]: high, low) fixed-effects structure.

4.2.2. Social impressions

Fig. 5 displays the main findings for Studies 3a and 3b. Note that we observed a significant main effect of Baseline Valence on all dimensions, $Fs > 40.78$, $ps < 0.001$, which showed that ratings improved as the baseline went from negative to neutral to positive.

4.2.2.1. Authenticity. We replicated the Variability main effect on authenticity, $F(1, 3154.60) = 45.62$, $p < .001$, whereby high-variability targets were judged as more authentic than low-variability targets (collapsing across the different baselines). As before, this Variability effect on increased judgments of authenticity was stronger for the neutral baseline condition ($b = 6.70$, $CI_{95} = [4.35, 9.04]$, $t(3154.20) = 5.60$, $p < .001$, $d_Z = 0.33$), and also significant across the positive baseline ($b = 4.83$, $CI_{95} = [2.48, 7.17]$, $t(3155.20) = 4.03$, $p < .001$, $d_Z = 0.24$) and negative baseline ($b = 2.48$, $CI_{95} = [0.13, 4.82]$, $t(3154.10) = 2.07$, $p = .039$, $d_Z = 0.12$), but these latter effects were less strong. Reflecting this pattern, the Baseline Valence × Variability interaction was significant, $F(2, 3154.30) = 3.13$, $p = .04$.

4.2.2.2. Happiness. We also replicated the happiness effects from Studies 1 and 2. The Variability main effect in Studies 3a and 3b, $F(1, 3021.50) = 74.25$, $p < .001$, demonstrated that participants thought high-variability targets looked happier than low-variability targets (collapsing across the different baselines). Once again, the largest variability effects occurred around the neutral baseline, being significantly stronger ($b = 9.72$, $CI_{95} = [7.43, 12.00]$, $t(3022.10) = 8.34$, $p < .001$, $d_Z = 0.50$) than the significant effect around the negative baseline ($b = 4.03$, $CI_{95} = [1.75, 6.31]$, $t(3020.90) = 3.46$, $p < .001$, $d_Z = 0.21$), and also stronger than the significant effect around the positive baseline ($b = 3.62$, $CI_{95} = [1.34, 5.91]$, $t(3021.40) = 3.11$, $p = .002$, $d_Z = 0.19$). Reflecting this pattern, the Baseline Valence × Variability interaction was significant, $F(2, 3021.60) = 8.56$, $p < .001$.

4.2.2.3. Power. We did not have any predictions for the power dimension, since there were no systematic effects in Studies 1 or 2. With the combined data from Studies 3a and 3b, however, we did observe a main effect of Variability, $F(1, 3032.30) = 10.75$, $p = .001$ (high variability deemed more powerful), and a marginal Baseline Valence × Variability interaction, $F(2, 3032.30) = 2.55$, $p = .08$. Given that these effects did not replicate (i.e., in the previous studies), we do not discuss them further.

4.2.2.4. Trust. Similar to Studies 1 and 2, we also observed somewhat weaker effects of variability on trust, albeit with a similar pattern as the authenticity and happiness dimensions. A main effect of Variability on trust in Studies 3a and 3b, $F(1, 2889.00) = 20.73$, $p < .001$, demonstrated that high-variability targets were deemed more trustworthy than low-variability targets (when collapsing across the different baselines). The variability effect was greatest around the neutral baseline (b = 4.14, CI_{95} = [1.89, 6.40], t(2889.10) = 3.60, p < .001, d_Z = 0.22), compared to the also significant effect around the negative baseline (b = 3.12, CI_{95} = [0.86, 5.37], t(2888.90) = 2.71, p = .007, d_Z = 0.17) and the (marginal) effect around the positive baseline (b = 1.83, CI_{95} = [−0.43, 4.08], t(2888.60) = 1.59, p = .12, d_Z = 0.10). Note, however, that the Baseline Valence × Variability interaction was not significant in Studies 3a and 3b, F(2, 2888.70) = 1.02, p = .36.

4.2.2.5. Leadership. The leadership dimension followed a similar pattern as the authenticity and happiness dimensions. We observed both a main effect of Variability in Studies 3a and 3b, F(1, 5573.20) = 11.88, p < .001 (high-variability judged more leader-like), along with a Baseline Valence × Variability interaction, F(2, 5573.20) = 11.70, p < .001. High-variability targets were judged to be more leader-like than low-variability targets, but this difference was strongest and only apparent when expressions varied around neutral (b = 5.36, CI_{95} = [3.58, 7.15], t(5573.00) = 5.89, p < .001, d_Z = 0.26), compared to the negative baseline (b = −0.46, CI_{95} = [−2.24, 1.33], t(5573.50) = −0.50, p = .62, d_Z = 0.02) and positive baseline (b = 0.53, CI_{95} = [−1.25, 2.32], t(5572.80) = 0.58, p = .56, d_Z = 0.03).

4.2.2.6. Team-member desirability. Results on team-membership desirability also followed a similar pattern as the authenticity and happiness dimensions. A Variability main effect, F(1, 5573.10) = 19.67, p < .001, showed that high-variability targets were also rated as more desirable team-members than low-variability targets. High-variability targets were judged to be more desirable team members than low-variability targets at the positive baseline (b = 2.29, CI_{95} = [0.45, 4.14], t(5572.50) = 2.44, p = .01, d_Z = 0.11) and neutral baseline (b = 3.60, CI_{95} = [1.75, 5.44], t(5572.70) = 3.83, p < .001, d_Z = 0.17), but not the negative baseline (b = 1.33, CI_{95} = [−0.51, 3.18], t(5573.00) = 1.42, p = .16, d_Z = 0.06). Like the trust ratings, the Baseline Valence × Variability interaction was not significant in Studies 3a and 3b, F(2, 5573.20) = 1.46, p = .23.

4.2.3. Multilevel mediation analysis

Next, using the between-participants rating data from Study 3b, we conducted multilevel mediation analyses to test four possible mechanisms (authenticity, happiness, power, or trust) for the relationship between variability and interpersonal judgments related to interactions with others (i.e., leadership and team-member desirability). We applied multilevel mediation analyses to each participant's data using the *mediation* package in R (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014). This strategy is effective for repeated-measures designs, since it takes a causal inference approach to allow for model-based estimation of the average total, direct, and indirect effects in hierarchical data structures (Imai, Keele, & Tingley, 2010). Our main predictor was variability (0 = low, 1 = high); our main DV was leadership (and then team-member desirability); and each of the rating dimensions (authenticity, happiness, power, and trust) were tested as mediators in separate models. All simulations were based on 1,000 bootstrapped samples per estimate, after which quasi-Bayesian confidence intervals were calculated around the total effect, average direct effect, and average indirect effect.

In preliminary mediation models, all path models and bootstrapped estimates controlled for baseline condition (positive, neutral, and negative). These analyses demonstrated authenticity as the strongest mediator between variability and leadership judgments (b = 2.22, CI_{95} = [0.64, 3.85], p < .001) as well as for team member judgments (b = 2.54, CI_{95} = [0.73, 4.35], p < .001). Happiness was also a significant mediator, but the effect was weaker than authenticity, for both leadership (b = 2.14, CI_{95} = [0.32, 4.12], p = .03) and team member judgments (b = 2.74, CI_{95} = [0.41, 5.19], p = .03). We did not find any mediating effects of power (leadership: b = −0.52, CI_{95} = [−2.29, 1.35], p = .62; team-member: b = −0.37, CI_{95} = [−1.63, 0.97], p = .62), or trust (leadership: b = 0.86, CI_{95} = [−1.52, 3.07], p = .44; team-member: b = 0.99, CI_{95} = [−1.79, 3.55], p = .44).

To examine specific moderated mediation effects by baseline valence, we then created separate multilevel mediation models *within* each baseline condition (positive, neutral, and negative). Table 1 displays the results of these analyses for leadership. Table 2 displays the results for team-membership desirability.

As predicted, within the neutral baseline condition, authenticity significantly mediated the relationship between variability and leadership, and as well as between variability and team-membership desirability. Happiness was also a significant mediator in both cases, only within the neutral baseline condition. Interestingly, authenticity was also a marginal mediator in the positive baseline condition, in both cases. We did not find any significant mediation effects in the negative baseline condition, nor any mediating effects of power or trust on professional judgments in any of the mediation models.

5. Study 4

Studies 3a and 3b demonstrated meaningful interpersonal consequences with respect to how people judge social others who display more or less variability in their emotional displays. At every baseline (positive, neutral, negative) when targets displayed high (vs. low) variability in their emotional displays, they were rated as more authentic, as well as happy and trustworthy (with the exception of one non-significant effect for trust around a positive baseline).

Yet, the effect of variability on rated professional qualities (i.e., leadership potential and team-member desirability), *through increased authenticity*, was only found around a neutral baseline. Hence, it appears that displaying variability in one's emotions leads to interpersonal benefits (such as within organizations), but only when targets displayed a mix of negative and positive emotion. This is a likely consequence of effects on authenticity being strongest around the neutral baseline (i.e., a mix of negative and positive emotion).

One alternate hypothesis for the results thus far is that variability is not leading to favorable impressions per se, but rather leading to more extreme social impressions. To test this alternative explanation, in Study 4, we measured impressions of authenticity, but also a negative trait, unfriendliness.

5.1. Method

5.1.1. Participants

As in our initial studies, we recruited 150 participants on Amazon Mechanical Turk, wherein 153 (see footnote 1) completed the study (M_{age} = 36.25 years, SD_{age} = 12.40 years; 62% female).

5.1.2. Materials and software

We used the same face stimuli (angry-to-happy morph continuum) and software (Inquisit Web 5.0; http://www.millisecond.com/) as in Studies 3a-3b. The only change in Study 4 involved the judgments that participants made for each target (see below).

5.1.3. Design and procedure

We used the same design and procedure as in Studies 3a-3b, but for each target, participants instead only gave ratings for *authenticity* (similar to previous studies) and *unfriendliness* (defined as how hostile, mean, or disagreeable they thought the person would be), using 100-point sliders (0 = *not at all*, 100 = *very much*).

Supplemental material. All data and analysis scripts are available for download at https://osf.io/62cqj/.

Table 1
Multilevel mediation results for emotion variability and *leadership* in Study 3b.

Outcome (DV)	Baseline valence	Mediator	Mediation effect [CI_{95}]	Direct effect [CI_{95}]	Total effect [CI_{95}]
Leadership	Negative	Authenticity	0.77 [−1.36, 2.97]	−2.61 [−7.08, 1.51]	−1.83 [−6.94, 2.90]
	Negative	Happiness	−0.31 [−2.90, 2.31]	−1.77 [−5.88, 2.04]	−2.08 [−6.71, 2.60]
	Negative	Power	−0.29 [−3.47, 2.69]	−0.14 [−4.35, 4.03]	−0.43 [−5.63, 4.75]
	Negative	Trust	2.00 [−1.25, 5.60]	−4.63 [−9.06, −0.40]*	−2.63 [−8.23, 2.76]
	Neutral	Authenticity	3.92 [1.11, 7.08]**	2.51 [−1.35, 6.35]	6.43 [1.64, 11.10]**
	Neutral	Happiness	4.50 [1.85, 7.48]**	0.07 [−3.95, 4.13]	4.56 [−0.30, 9.30]†
	Neutral	Power	0.78 [−2.62, 4.32]	2.10 [−1.08, 5.35]	2.87 [−1.75, 7.59]
	Neutral	Trust	1.78 [−1.25, 5.23]	1.48 [−2.43, 5.33]	3.26 [−1.81, 8.63]
	Positive	Authenticity	2.45 [−0.45, 5.39] †	−3.72 [−6.74, −0.46]*	−1.27 [−5.59, 2.85]
	Positive	Happiness	1.72 [−0.91, 4.29]	−0.18 [−3.42, 3.12]	1.54 [−2.37, 5.63]
	Positive	Power	−2.26 [−5.51, 0.78]	−0.26 [−3.90, 3.08]	−2.52 [−6.85, 2.31]
	Positive	Trust	−0.86 [−4.22, 2.16]	1.28 [−2.12, 4.60]	0.42 [−4.57, 4.66]

Note. Emotion variability (low = 0; high = 1) was the independent variable in all mediation models. ***p ≤ 0.01, *p ≤ 0.05, †p ≤ 0.10.*

5.2. Results

5.2.1. Analysis strategy

We used a similar MLM analysis strategy as in Studies 2 and 3a-3b. In Study 4, we generated MLMs on each rating dimension, according to a Baseline Valence (3 [within-subjects]: positive, neutral, negative) × Variability (2 [within-subjects]: high, low) fixed-effects structure.

5.2.2. Social impressions

Fig. 6 displays the main rating results for Study 4.

5.2.2.1. Authenticity. On the authenticity dimension, we observed main effects for Baseline Valence, $F(2, 1670.48) = 64.17$, $p < .001$, and Variability, $F(1, 1670.85) = 11.93$, $p < .001$.

The Baseline Valence main effect showed that participants found targets varying around the positive baseline (50% happy) to appear more authentic than those at the neutral baseline (0% happy/0% angry) and negative baseline (50% angry).

The Variability main effect replicated the authenticity results from Studies 1–3, whereby high-variability targets were rated as more authentic than low-variability targets (when collapsing across baselines). However, similar to the prior studies that manipulated the baseline, this Variability main effect seemed driven by the neutral baseline condition (high-variability targets were deemed more authentic than low-variability targets when varying around the neutral point; $b = 4.91$, $CI_{95} = [1.43, 8.40]$, $t(1669.30) = 2.77$, $p = .006$, $d_Z = 0.22$), rather than the non-significant effect for the positive baseline condition ($b = 2.36$, $CI_{95} = [-1.13, 5.85]$, $t(1671.30) = 1.33$, $p = .18$, $d_Z = 0.11$) or the marginal effect for the negative baseline condition ($b = 3.36$, $CI_{95} = [-0.12, 6.85]$, $t(1670.40) = 1.89$, $p = .06$, $d_Z = 0.15$). Note, however, that the Baseline Valence × Variability interaction was not significant, $F(2, 1670.13) = 0.52$, $p = .59$.

5.2.2.2. Unfriendliness. If variability simply increases the extremity of social judgments, then high (vs. low) variability should increase unfriendliness ratings. Instead, if emotional variability increases the favorability of social impressions, it should decrease unfriendliness ratings. The latter was the case. We observed main effects for both Baseline Valence, $F(2, 1669.49) = 353.79$, $p < .001$, and Variability, $F(1, 1669.76) = 18.79$, $p < .001$.

The Baseline Valence main effect showed (unsurprisingly) that participants judged targets varying around the negative baseline (50% angry) to appear more unfriendly than those at the neutral baseline (0% happy/0% angry) and positive baseline (50% happy).

The Variability main effect showed that high-variability targets were judged to be *less* unfriendly than low-variability targets (when collapsing across baselines). These differences were strong and significant around the neutral baseline ($b = 5.86$, $CI_{95} = [2.33, 9.39]$, $t(1668.70) = 3.25$, $p = .001$, $d_Z = 0.26$) and negative baseline ($b = 6.58$, $CI_{95} = [3.05, 10.12]$, $t(1669.40) = 3.66$, $p < .001$, $d_Z = 0.30$), but not around the positive baseline ($b = 1.09$, $CI_{95} = [-2.45, 4.62]$, $t(1670.10) = 0.60$, $p = .55$, $d_Z = 0.05$). Similar to the authenticity ratings, note that the Baseline Valence × Variability interaction was not significant, although marginal, $F(2, 1669.23) = 2.75$, $p = .06$.

6. Study 5

Study 4 confirmed that high (vs. low) variability in emotional displays increased the favorability of social impressions (not the extremity

Table 2
Multilevel mediation results for emotion variability and *team-member desirability* in Study 3b.

Outcome (DV)	Baseline valence	Mediator	Mediation effect [CI_{95}]	Direct effect [CI_{95}]	Total effect [CI_{95}]
Team-member desirability	Negative	Authenticity	0.87 [−1.68, 3.39]	−3.22 [−7.63, 1.00]	−2.34 [−7.33, 2.67]
	Negative	Happiness	−0.40 [−4.06, 3.15]	−2.86 [−6.49, 0.48]	−3.26 [−8.26, 1.87]
	Negative	Power	−0.23 [−2.71, 2.19]	−0.25 [−4.57, 3.69]	−0.49 [−5.26, 4.27]
	Negative	Trust	2.14 [−1.87, 6.04]	0.58 [−3.43, 4.26]	2.71 [−2.44, 7.91]
	Neutral	Authenticity	4.38 [1.31, 7.76]**	−0.91 [−4.53, 2.89]	3.47 [−1.36, 8.32]
	Neutral	Happiness	6.52 [2.65, 10.27]**	−3.79 [−6.76, −0.68]*	2.73 [−2.00, 7.26]
	Neutral	Power	0.54 [−1.47, 2.85]	1.18 [−2.12, 4.51]	1.71 [−2.14, 5.53]
	Neutral	Trust	2.05 [−1.51, 5.77]	−2.05 [−5.12, 0.96]	0.004 [−4.60, 4.50]
	Positive	Authenticity	2.88 [−0.62, 6.46]†	−3.58 [−6.11, −1.10]**	−0.70 [−4.86, 3.33]
	Positive	Happiness	1.72 [−0.97, 4.41]	1.14 [−1.89, 4.51]	2.86 [−1.01, 6.93]
	Positive	Power	−1.20 [−3.07, 0.38]	−0.20 [−3.86, 3.34]	−1.40 [−5.43, 2.56]
	Positive	Trust	−0.98 [−5.33, 3.29]	0.94 [−1.51, 3.38]	−0.04 [−4.98, 4.57]

Note. Emotion variability (low = 0; high = 1) was the independent variable in all mediation models. ***p ≤ 0.01, *p ≤ 0.05, †p ≤ 0.10.*

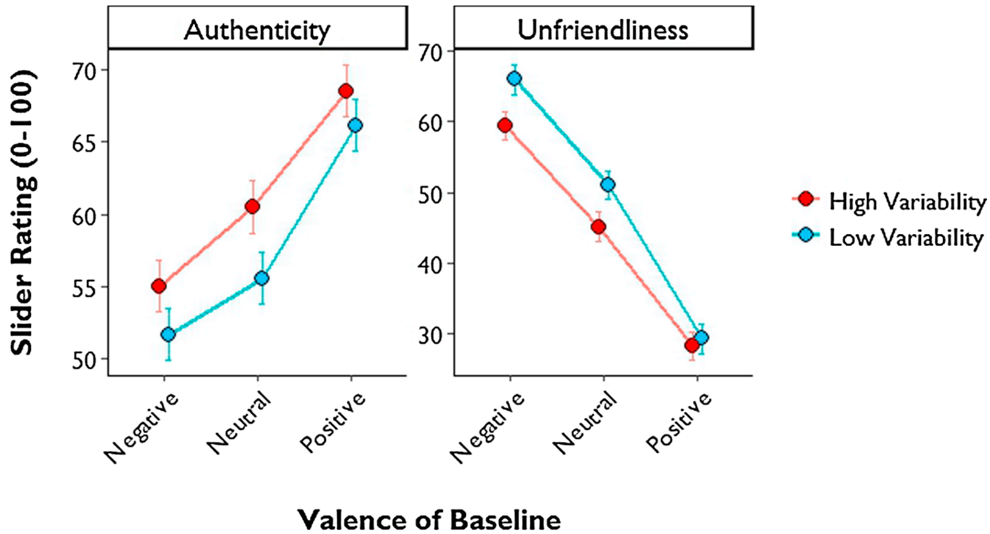

Fig. 6. Main results for Study 4. Error bars = ± 1 SEM.

of social impressions). Targets who displayed high variability in their emotional displays (particularly when with a mix of negative and positive emotions) were seen as more authentic, and less unfriendly (even despite that in the high variability conditions, those targets displayed more negative emotions).

In a final study, we sought to rule out another alternative explanation for the present results. In all our designs thus far, per each target, the exposures were titrated so that the overall average of happy/angry features was equal between the high and low-variability conditions. Thus, any differences between conditions would not be from the mean features displayed (held constant across conditions). For instance, with a neutral baseline, the mean display across both low and high variability conditions was neutral (high variability targets ranging from 75% angry to 75% happy; low-variability targets ranging from 25% angry to 25% happy). Yet, in the high variability conditions, participants were also exposed to more extreme versions of the emotions. Perhaps it is this emotion extremity that is responsible for the effects we report. To examine this alternative hypothesis, in a final study we implement a new paradigm.

Our new paradigm (described below) held constant the average valence and average emotional intensity across our two conditions, while only manipulating variability in emotional displays, here now manipulating how many unique emotions the targets displayed.

6.1. Method

6.1.1. Participants

Similar to previous studies, we recruited 150 participants on Amazon Mechanical Turk; 150 completed the study (M_{age} = 37.16 years, SD_{age} = 12.35 years; 55% female).

6.1.2. Materials

We replaced the CFD target faces used in Studies 1–4 with a new set of morphs of static photographs that we generated from the Amsterdam Dynamic Facial Expression Set (ADFES; van der Schalk, Hawk, Fischer, & Doosje, 2011). Our new paradigm required multiple negative emotions to test our main questions (which were not available in the CFD). Consequently, we also thus extend our findings to a different stimulus set.

We selected 12 different models from the ADFES to use for morphing (6 White males and 6 White females). Using the angry, happy, fearful, sad, and neutral images for each model, we generated four unique morphs for each model (by blending each emotion expression with the neutral expression for that model): yielding faces that were 50% happy, 50% angry, 50% fearful, and 50% sad. Like in our previous studies, note that all the stimuli were single-person morphs (images of different individuals were never blended together), and all the faces were cropped so that only the facial features were visible. This created a set of 48 unique stimuli (12 different models, each displaying four unique emotions of 50% intensity). Other changes in Study 5 pertained to our new variability conditions and rating dimensions, which we detail below.

6.1.3. Software

We used the same software as in Studies 1–5 to ensure precise stimulus timing and presentation (Inquisit Web 5.0; http://www.millisecond.com/).

6.1.4. Design and procedure

We used the same design and procedure as in Studies 1 and 4, but with two main changes. First, our high- and low-variability conditions were now defined by the *number of different emotions that each target displayed* (rather than the magnitude/intensity, as with Studies 1–4). Fig. 7 depicts this new paradigm.

Each target displayed 30 expressions, after being randomly assigned to the high-variability or low-variability condition. In the high-variability condition, targets displayed 4 different emotions: an emotion that was 50% happy (1/2 of all exposures), an emotion that was 50% angry (1/6 of all exposures), an emotion that was 50% fearful (1/6 of all exposures), and an emotion that was 50% sad (1/6 of all exposures). Across all exposures, all emotions were displayed at 50% intensity, and half of the displays were of positive valence, and half negative valence.

In the low-variability condition, targets only displayed 2 different emotions: an emotion that was 50% happy (1/2 of all exposures) and an emotion that was 50% angry (1/2 of all exposures). Again, across all exposures, all emotions were displayed at 50% intensity, and half of the displays were of positive valence, and half negative valence.

This design thus controls for the overall valence and magnitude of the expressions across variability conditions; the only difference is the number of distinct (negative) emotions that each target expresses. Note that the additional emotions added for the high variability needed to be negative emotions as there is only one readily recognizable facial expression that is unambiguously linked to positive emotion (i.e., happiness).

Second, for simplicity (and to align with the goals of Study 4), we only asked participants in Study 5 to rate authenticity (like our previous studies) and negativity (i.e., how much negativity do you think they experience/display in their daily lives), using 100-point sliders (0 = *not*

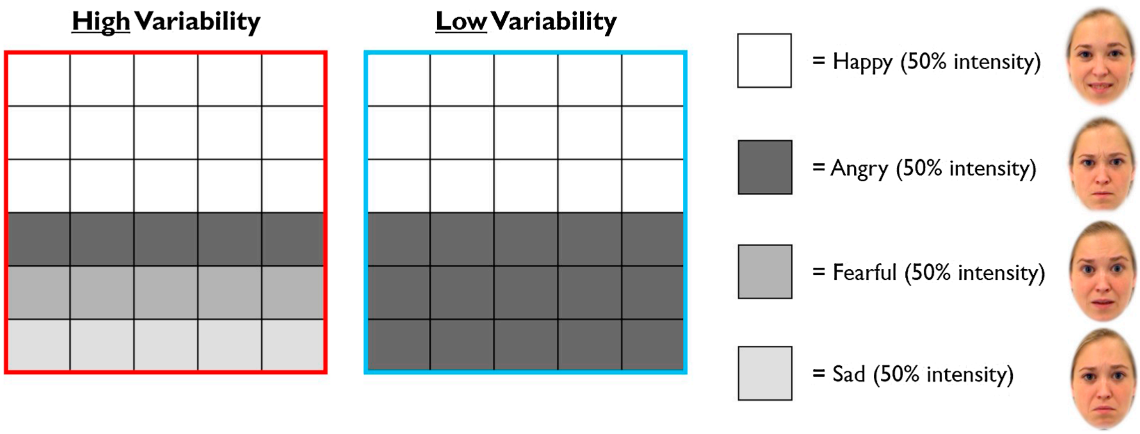

Fig. 7. Design of stimulus presentation for the high- and low-variability conditions in Study 5. Participants were exposed to 30 sequential presentations of different face images from the same target (500-ms exposure + 100-ms ITI each), and this was repeated for 12 different male and female targets. Each box in the grids above represent 1 expression presentation. In both the high-variability and low-variability conditions, the target would display 15 happy expressions (1/2 of all expressions). In the high-variability condition, the rest of the exposures were evenly split between anger (1/6 of all expressions), fear (1/6 of all expressions), and sadness (1/6 of all expressions). In the low-variability condition, the only negative emotion displayed was anger (1/2 of all expressions). All emotions were displayed at 50% intensity. This design thus controls for the overall valence and magnitude of the expressions across variability conditions; the only difference is the number of distinct (negative) emotions that each target expresses.

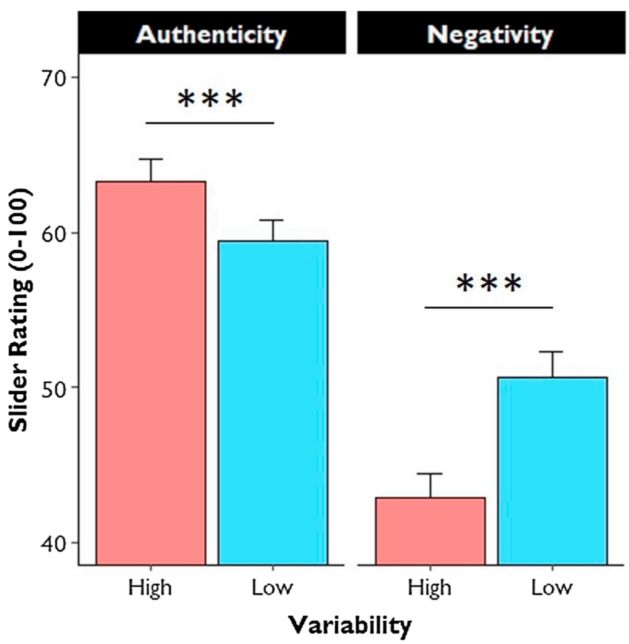

Fig. 8. Main results for Study 5. Error bars = ± 1 SEM. $^{***}p \leq 0.001$.

at all, 100 = *very much*).

Supplemental material. All data and analysis scripts are available for download at https://osf.io/62cqj/.

6.2. Results

6.2.1. Analysis strategy

We used a similar MLM analysis strategy as in Studies 1 and 4. In Study 5, we generated MLMs on each rating dimension, which included Variability (within-subjects: high, low) as the fixed-effect predicting social ratings.

6.2.2. Social impressions

Fig. 8 displays the main rating results for Study 5. As predicted, high-variability targets were rated as more authentic than low-variability targets (b = 3.91, CI_{95} = [1.97, 5.85], t(1643.50) = 3.95, p < .001, d_Z = 0.32). Critically, on the negativity dimension, this effect reversed: High-variability targets were judged to be *less* negative than low-variability targets (b = 7.78, CI_{95} = [5.83, 9.73], t(1642.00) = 7.83, p < .001, d_Z = 0.64).

7. General discussion

The current studies demonstrate that when individuals display variability in their emotional expressions, they are evaluated by others more favorably. We demonstrated that high-variability in facial emotion makes one appear more authentic, which in turn leads to more favorable social impressions. This even extends to emotion perception, whereby high-variability individuals also look happier than low-variability individuals, despite displaying more intense negative facial features. Variability led to more positive impressions on related dimensions like trustworthiness, as well as had implications for applied settings such as leadership potential and team-membership desirability, effects mediated by increased perceptions of authenticity (and to a lesser extent, happiness).

Expressions of emotional variability did not only increase these favorable social impressions, but they also decreased negative social impressions (e.g., unfriendliness), despite our high variability conditions containing more negative features (along with more positive features). Note that our effects cannot be explained by differences in the dynamicity of the stimuli (i.e., images in the high- and low-variability conditions updated with equal frequency) or the specific targets that displayed the expressions (i.e., targets were randomized and counterbalanced to variability conditions in all studies). Additionally, our results confirmed that these effects were not based in the intensity of emotional displays, but rather variability in the emotions expressed by targets. Generally, our findings provide support for the *social-inferential model* we proposed herein: Emotion variability is a social cue in-and-of-itself that can make someone appear more authentic and trustworthy. It does not seem, in contrast, that a mere extraction of objective “average” features (*feature-extraction models*) is sufficient to describe how people generate first impressions of faces.

Recall that such *feature-extraction models* would predict that participants will summarize over all exposures to someone’s face (regardless of how their emotional facial features vary across exposures). Simply put, any variability in emotional features would be noise to be averaged over, and thus, such models would predict no difference in social impressions between high- and low-variability conditions (given that the summary representation would be equal in both cases).

While we did observe clear differences in social impressions based on variability, it is worth noting that the baseline main effects in our studies do show that people can recognize and estimate mean emotional features across a sequence of expressions. That is, when the mean of the facial expressions was positive, people did form significantly more favorable impressions than if the mean was neutral or negative. And thus, people clearly do summarize over repeated expressions as would be predicted by *feature-extraction models.* A *social-inferential model* agrees that people create a "gist" or summary representation for the emotional expressions, but we propose also considers the larger context of the emotional displays, whereby variability is not simply noise, but socially informative.

Speaking to the role of context effects, we did not find that variability consistently influenced impressions of social power. This is likely due to the fact that power is inherently contextual (Hall, Coats, & LeBeau, 2005). Whether high- or low-variability appears powerful should depend on the situational nature of the displayed emotions and the target-perceiver relationship (Carr, Winkielman, & Oveis, 2014; Mast, 2010; Smith & Magee, 2015). Indeed, there is evidence that powerful people both more openly express their emotions (Berdahl & Martorana, 2006), but also more effectively regulate their emotions in dyadic conversations (van Kleef et al., 2008). That being said, the fact that power was mostly unaffected by variability shows that our results are not a mere "halo effect" of high-variability targets being perceived as more positive on any social dimension. In other words, it seems that the benefits of being perceived as emotionally variable seem to be most strongly tied to social impressions that are more directly tied to the regulation of emotion displays (i.e., authenticity).

Relatedly, while variability effects on the trust dimension were generally in the same direction as authenticity and happiness ratings, they seemed to be weaker overall. This might suggest that trustworthiness is a more distal (and "noisy") cue taken from variability, compared to authenticity and happiness. Especially given that high-variability targets periodically displayed more negative expressions, this negativity could be interfering with an effect on trust judgments. This also likely reflects the inherent complexity and heterogeneity that is involved with judging someone else as trustworthy. For instance, trustworthiness can be focused purely on appearance (e.g., Todorov, Baron, et al., 2008), but impressions of trust can be linked to a host of distinct behaviors, such as deception, aggression, and criminality (Wilson & Rule, 2017), and are linked to a variety of different motives (e.g., Slepian, Young, & Harmon-Jones, 2017; Young, Slepian, & Sacco, 2015). Future studies may examine these more specific aspects of trustworthiness to delineate the situations where variability would be taken as socially meaningful for trust-related judgments (e.g., apparent vs. behavioral trustworthiness; see Slepian & Ames, 2016).

Emotional variability had its strongest effect on judgments of authenticity when a mix of positive and negative facial features were displayed. In our most high-powered study (i.e., Study 3 which recruited a larger sample size for testing mediation effects), we did find that variability around both a positive, and a negative, baseline increased judgments of authenticity. That said, in other studies, the effect on authenticity was not apparent when confined to only positive or negative emotions.[2]

That the effect is strongest around a neutral baseline might be a reflection of variability being more visible when covering a range of positive and negative expressions. Given the significance and vividness of both angry faces (Pinkham, Griffin, Baron, Sasson, & Gur, 2010) and happy faces (Becker & Srinivasan, 2014), large deviations within these emotional expressions may not feel very different from smaller deviations.

Alternatively, people might draw different social inferences from the display of a mix of negative and positive emotions (relative to a mix of only positive, or only negative, emotions). A mix of negative and positive displays could reflect a person is not holding back their "true" emotions (and thus, appearing especially authentic). It also could be the case that low-variability around a neutral baseline is interpreted as being devoid of emotional expression (and thus, appearing especially *inauthentic*).

It is especially intriguing that high-variability can make others appear happier, even when the objective feature average is the same as someone with low-variability. This suggests a fundamental rethinking about what happiness judgments signal. A happy person need not "look" happy to be judged as such, as factors extraneous to an emotional display may impinge on judgments (Barrett et al., 2011). This also highlights the fundamental complexity of smiles (Becker & Srinivasan, 2014), which can take on a variety of different meanings depending on the context (Rychlowska et al., 2017), even aside from the basic bottom-up perceptual features (Carr et al., 2017). Follow-up studies should further examine the subtle social cues that accompany the relationship between authenticity and happiness, especially in how they could change or dissociate in different contexts (Thibault, Levesque, Gosselin, & Hess, 2012; Tng & Au, 2014).

Could there also be situations where greater variability in facial emotion leads to more *negative* social impressions? This would logically follow from previous work showing that emotion-regulation abilities positively impact social functioning (whereby swinging between emotions would be a marker of instability; Gross, 2002; Lopes et al., 2005; Ochsner & Gross, 2005; Zaki & Williams, 2013). Indeed, the ability to flexibly regulate one's own affective states (as indicated through behavioral and physiological measures) can lead to improved prosociality and social sensitivity (Kogan et al., 2014; Muhtadie, Koslov, Akinola, & Mendes, 2015). Also, individuals that feel powerful tend to more effectively regulate their emotions when interacting with others (van Kleef et al., 2008).

In certain situations, high-variability might therefore be a negative social cue if that person seems unable to control their emotional expressions (thus appearing unstable or "unhinged"). This should be explored in future studies, perhaps using methods to amplify variability-related social cues (e.g., using affective voices or other nonverbal behavior paired with faces, and thus also examining these effects using multimodal paradigms; Campanella & Belin, 2007; Kreifelts, Ethofer, Grodd, Erb, & Wildgruber, 2007; Schirmer & Adolphs, 2017; Slepian, Young, Rutchick, & Ambady, 2013; Weisbuch, Slepian, Clarke, Ambady, & Veenstra-Vander Weele, 2010). Alternatively, future work might explore how cues of dominance or leadership combine with variability's influence other social judgments (Weisbuch, Slepian, Eccleston, & Ambady, 2013). Future studies could also test different underlying distributions of facial expressions (rather than only uniform distributions, as used in our studies; see Dotsch, Hassin, & Todorov, 2016). These effects also will likely depend on other social aspects of the target displaying the emotion. Future research could investigate the effects of variability at different intersections of target race, gender, and/or age (Hugenberg, 2005; Slepian, Weisbuch, Adams Jr., & Ambady, 2011; Sutherland et al., 2013).

Finally, our findings for leadership suggest a new picture of what a leader looks like—perhaps someone that is more authentic and "readable" in their expressions. Indeed, perceptions of authenticity and happiness from variability led targets to seem more leader-like. This builds on a variety of previous studies looking at impression formation in professional contexts, particularly when judging static facial features (Olivola & Todorov, 2010; Olivola et al., 2012; Rule & Ambady, 2011b; Thora & Rule, 2017). These ideas suggest important questions regarding real-world judgments that have implications for applied settings, such

[2] We conducted an additional study that examined whether variability in motivational orientation (approach vs. avoidance) influenced judgments of authenticity. When this question was tested, it was confined, however, to negative emotional displays. The data suggested that *within negative emotions*, variability of motivational orientation might not influence judgments of authenticity (see SOM).

as leadership in organizations and team-membership selection, particularly given how first impressions of faces can predict concrete measures of professional success (e.g., company growth and profits; Antonakis & Eubanks, 2017; Graham, Harvey, & Puri, 2016; Re & Rule, 2016; Rule & Ambady, 2008b, 2011a).

In the current studies, we demonstrate that people are not only their headshots. Our results suggest that social evaluations are quite malleable based on the variability of subsequent exposures to that same individual. In sum, our studies show that cues of facial emotion variability are combined with the perception of "objective" facial features to create rapid social evaluations. Future models of face evaluation should reference not only the extraction of summary statistics, but also the social inferences drawn from the summary statistics themselves.

Appendix A. Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.cognition.2018.10.009.

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