American Journal of Applied Psychology
2025, Vol. 14, No. 1, pp. 1-13
https://doi.org/10.11648/j.ajap.20251401.11

Research Article

Role of Dynamic Facial Expressions in Judgement of Attractiveness: AI and Human Analysis

Mayu Yamaguchi[1], Kazuhiro Ikeda[2], Yayoi Kawasaki[3], Eriko Sugimori[3, *]

[1]Graduate School of Human Sciences, Waseda University, Tokorozawa City, Saitama, Japan
[2]Department of Psychology, Shokei Gakuin University, Natori City, Miyagi, Japan
[3]Faculty of Human Sciences, Waseda University, Tokorozawa City, Saitama, Japan

Abstract

Facial attractiveness plays a crucial role in social interactions and mate selection, influencing judgments and behaviors in various contexts. While extensive research has examined structural facial features such as symmetry and averageness, the dynamic and modifiable nature of facial expressions remains underexplored. This study explores the influence of dynamic, modifiable facial expressions on perceived attractiveness through two experiments utilizing both human raters and artificial intelligence (AI) to analyze the relationship between facial expression positivity and attractiveness. In Experiment 1, we examined the effects of the experimenter's control over the facial expressions on the facial expression and attractiveness ratings using two types of videos: one in which the stimulus models introduced themselves and another in which the subjects were controlled to be expressionless. Results revealed that the positivity and intensity of facial expressions, as assessed by facial expression analysis software, fluctuated based on the experimenter's manipulation. Additionally, the variation in raters' evaluations of facial expression positivity led to corresponding changes in attractiveness ratings. In Experiment 2, we investigated the relationship between facial expression ratings by humans and AI and their connection to attractiveness. The positivity of facial expressions in the video stimuli was analyzed by students and an AI-based facial expression analysis software, whereas a separate group of students rated the attractiveness of the same stimuli. Findings showed a positive correlation between the attractiveness ratings for both male and female stimuli and the positivity of facial expressions rated by both humans and AI. This indicates that attractive faces were perceived as having positive expressions and the actual positivity of the expressions themselves influenced attractiveness evaluations. These findings indicate that positivity in facial expressions plays a significant role in attractiveness perception. Future research should investigate how the relationship between attractiveness and expressions may be shaped by evolutionary pressures and social behaviors.

Keywords

Facial Expression, Attractiveness, Facial Impression, Face Perception

*Corresponding author: sugimori@waseda.jp (Eriko Sugimori)

Received: 19 December 2024; **Accepted:** 6 January 2025; **Published:** 22 January 2025

1. Introduction

Facial attractiveness plays an important role in social life. Attractive faces capture people's attention [1] and can be advantageous in various situations such as election outcomes [2, 3] and mating success [4].

Several researchers have explored the question of what makes a face attractive and have revealed the components of attractiveness. Most studies on this subject have focused on structural features. For example, faces with higher averageness and symmetry of facial structure, as well as sexual dimorphism are considered more attractive [5, 6]. Facial expressions have been shown to be a factor distinct from facial structural features. For example, studies have shown that people who smile more are judged as more attractive [7, 8]. However, few studies have focused on the influence of non-structural features such as facial expressions. Rhodes [5] examined the influence of various factors of attractiveness through a meta-analysis but did not consider the effect of emotional expressions owing to the lack of sufficient empirical studies and theoretical considerations. Therefore, there is insufficient research on the influence of facial expressions on attractiveness.

Researchers have primarily examined the association between facial expressions and attractiveness using two approaches. The first involves participants rating only the attractiveness of targets posing with different facial expressions and comparing attractiveness ratings across poses (e.g., [8, 9]). The second approach asks participants to rate either the physical attractiveness, the positivity of facial expressions, or both, and then examines the correlation between these ratings [10, 11]. However, both methods have limitations related to the validity of the stimuli and the participants' evaluation methods. This study seeks to clarify the influence of individuals' facial expressions on their attractiveness ratings while addressing these limitations.

A common limitation of the two methods is that a significant amount of psychological data on the perception and recognition of faces relies on static images of faces as stimuli rather than video recordings or live observation. Studies examining the relationship between facial expressions and attractiveness are no exception (e.g., [8, 9]). However, in the real world, faces are observed in motion. Static images do not convey diverse and complex information such as facial tilts, nods, eye movements, and especially, changes in facial expression. The information derived from observing motion facilitates the perception of the social context of everyday relationships [11]. Thus, methods that use static pictures of faces have been criticized regarding their ecological validity [12, 13].

A comparative study using static and dynamic images to date demonstrated that correlations between the attractiveness ratings of static and dynamic faces are low, indicating differences in the perception of dynamic and static faces [14]. Rubestein [14] asked participants to rate the attractiveness and facial expressions of target faces presented in videos or static images. The results showed low correlations between attractiveness ratings for static and dynamic faces; furthermore, for dynamic images, more positive emotions tended to be perceived for more attractive faces and more negative emotions for less attractive faces, whereas no such relationship was found for static images. These results indicate differences in the perception of dynamic and static faces: although static faces may be evaluated for attractiveness based primarily on their facial structure, dynamic faces can be evaluated for attractiveness influenced by socially relevant cues and emotions. Regarding emotion recognition, an fMRI study of a passive emotion perception task showed that dynamic stimuli enhanced emotion-specific brain activation patterns more than static stimuli [15]. Moreover, behavioral studies have shown that, compared with static stimuli of facial emotions, dynamic stimuli help recognize emotions more accurately [16-18].

In addition to the lack of perceived dynamic information in static images, the use of static facial expressions has limitations in terms of naturalness. Posed facial expressions are stronger and less ambiguous than spontaneous facial expressions because there is a clear intention to convey the desired emotion [19]. Therefore, expressions in everyday life and posed expressions may differ, and the finding that posed facial expressions affect attractiveness ratings, which has been revealed in studies of static images, may not apply in daily life. Thus, dynamic stimuli may be appropriate for examining the effect of emotional expressions on perceived facial attractiveness.

In recent years, several studies have focused on the differences in attractiveness judgments between static and dynamic images; however, the results have been inconsistent across studies. Kościński [20] conducted an experiment comparing participants' attractiveness ratings in videos versus static images. In the video condition, participants enacted a scene in which they meet an attractive member of the opposite sex. They began by looking to the left (toward a phone placed 30° from the camera), then turned their gaze and head toward the camera, smiled, and said, "Hi, I'm Ann" (or "Tom" for men). In the static image condition, participants posed with a neutral facial expression, mouths closed, and looked directly into the camera. Participants in the video condition were rated as more attractive compared to those in the static image condition. Similarly, Rubenstein [14] compared moving images with neutral facial expressions while reading cue cards for static images with neutral facial expressions, closed mouths, and direct gazes. Unlike Kościński [20], Rubenstein [14] found no difference in attractiveness ratings between the two conditions. A possible explanation for this discrepancy in findings could be the variation in the content of the dynamic images used. To date, no study has systematically examined how differences in the content of dynamic images influence attractiveness ratings. Roberts et al. [21] suggested that the context in which dynamic images are recorded significantly impacts the correlation between ratings of dynamic and static images. Furthermore, they emphasized the importance of carefully selecting dynamic scenarios to ensure ecological validity. These findings highlight the necessity of considering the context of dynamic stimuli when assessing attractiveness. Even when using videos, selecting their content is critical; any form of control that deviates from natural daily-life scenarios may distort the impressions formed by viewers.

The method in which participants are asked to rate both attractiveness and facial expression can overcome the limitations of static images, which do not convey dynamic information and use posed, unnatural stimuli because there is no need to control the facial expression of the stimulus. However, the second limitation involves the possibility that the perceiver's unconscious attractiveness ratings may influence conscious facial expression ratings. People can judge the attractiveness of a face that they have seen only for a short time. For instance, Locher et al. [22] revealed that the attractiveness of a face can be ascertained by viewing it for 100 milliseconds. Furthermore, Olson and Marshuetz [23] found that people can judge the attractiveness of a presented face based on visual information obtained within 13 ms. Facial attractiveness is perceived in real time and may influence subsequent decision-making [23]. Therefore, to investigate whether facial expressions influence the perception of attractiveness, it is necessary to use a method that evaluates facial expressions without the influence of attractiveness.

As discussed earlier, numerous studies have highlighted the impact of facial expressions on the perception of attractiveness; however, the experimental methods in these studies often face significant limitations regarding stimuli and evaluation approaches. This study sought to examine the effects of facial expressions on attractiveness while addressing these methodological challenges.

Experiment 1 aimed to study how the experimenter's control of the video of the stimulus model impacts the model's facial expressions and attractiveness ratings. We investigated differences in facial expressions using two types of videos: one in which the stimulus models introduced themselves and another in which the subjects were controlled to be expressionless. Based on previous studies, the selection of video content and method of controlling facial expressions are important, even when videos are used to examine the relationship between facial expressions and attractiveness. Specifically, to examine the effects of facial expressions in everyday situations, it is not appropriate to control facial expressions such that they differ from those in everyday life, such as by asking subjects to express a specific facial expression. However, depending on the method of control, the facial expressions may not be sufficiently articulated to be statistically analyzable; in this regard, no study has quantitatively examined how expressions change with the experimenter's control. Therefore, in this study, we examined whether the facial expressions of the stimulus models were altered by the experimenter's instructions by evaluating the facial expressions of the stimulus models using facial expression analysis software. Furthermore, we asked the raters to evaluate the attractiveness of the two videos and examined whether the experimenter's control of facial expressions influenced the attractiveness of the images.

Experiment 2 addressed the second limitation—the possibility that perceivers' unconscious ratings of attractiveness influence their conscious ratings of facial expressions—and tested whether a relationship exists between attractiveness and natural facial expressions. To examine whether facial expressions affect attractiveness without being influenced by attractiveness, participants and the facial expression analysis software rated the positivity of facial expressions to the video stimuli, and a different participant rated the attractiveness of the facial expressions.

2. Experiment 1

2.1. Methods

2.1.1. Participants

We recruited 62 Japanese undergraduate and graduate students (26 male, 36 female; mean age = 20.32 years, *SD* = 1.12, age range: 18–23 years) as raters. They were recruited from the Tokorozawa Campus of Waseda University.

Sixteen Japanese undergraduate and graduate students (8 male, 8 female; mean age = 21.69 years, *SD* = 1.40, age range: 19–24 years) participated as stimulus models. These students were recruited from the Waseda campus of Waseda University and were not acquainted with any of the participants.

All participants were healthy Japanese undergraduates with normal vision and no history of taking psychedelic medication.

2.1.2. Stimuli

The stimulus models were instructed to wear a white shirt and remove any glasses or jewelry prior to recording. They were then video-recorded in front of a plain white background in a room blocked from sunlight by curtains and lit with standard fluorescent lighting.

Two types of videos were recorded: one in which the model naturally introduced themselves as they might in a real-life setting, looking straight at the camera for 60 seconds (self-introduction video), and another in which the model counted numbers with a neutral expression while looking straight at the camera for 60 seconds (non-emotional video). For the non-emotional video, the models were asked to count starting from 11, so that participants would not be aware of the context of the video. Video stimuli were subsequently created using Avidemux (version 2.7.8), cropping the frame just above the top of the head and just below the middle of the neck. The videos were muted, and a 10-second intermediate segment from the original 60-second recording was extracted to prevent participants from discerning the models' speech. All videos were saved in MPEG-4 format at 30 fps. A total of 32 videos (16 self-introduction and 16 non-emotional) were used in this experiment.

2.1.3. Procedure

The raters were divided into two groups of 31 raters (13 male and 18 female) each. Each participant in either group watched the videos of the 16 models once, with half of the models (4 male and 4 female) in the emotional video and the other half (4 males and 4 females) in the non-emotional video. We switched the combination of video contents presented between the groups such that the same model could be seen only once in either video. That is, one video of each model received 31 ratings. After watching each model's video for 10 s, the raters used a 7-point scale to rate the model's facial attractiveness (1 = very unattractive, 7 = very attractive) and facial expressions (1 = very negative, 7 = very positive). No time limit was set for the evaluation. Once a rater rated a video, another video was presented. The order of presentation of the stimuli was randomized and counterbalanced between raters.

2.1.4. Facial Expression Measurements

To analyze facial expressions, we used the Kokoro Sensor, an emotion recognition software developed by CAC Corporation in Japan. The Kokoro Sensor uses an artificial intelligence tool for emotion recognition called AFFDEX, which was developed by Affectiva based on Ekman and Friesen's Facial Action Coding System (FACS) theory [24]. AFFDEX first detects facial landmarks, extracts textural features, classifies facial actions, and then models emotional expressions using FACS theory [24]. For each processed frame, this software offers a discrete categorization of seven emotions—joy, contempt, fear, disgust, anger, surprise, and sadness—based on Action Units (AUs) and gives these expressions a score from 0 (not expressed at all) to 100 (expressed) [25].

Additionally, the software provides indices for dimensional affective states, such as engagement and valence. According to the Affectiva website, engagement—also referred to as expressiveness—is defined as "a measure of facial muscle activation that illustrates the subject's emotional engagement" [26]. Engagement is calculated from the weighted sum of some AUs, with a variable index ranging from 0 to 100, where 0 indicates no engagement and 100 represents total engagement. Valence, meanwhile, is described as "a measure of the positive or negative nature of the recorded person's expression" [26]. It is determined based on a set of observed facial expressions, with values ranging from -100 to 100, where -100 indicates negative valence and 100 represents positive valence.

Affectiva has built a solid infrastructure using machine learning and deep learning methodologies to train and test facial expression algorithms on a large scale, with over five million facial videos containing approximately two billion facial frames analyzed in 75 countries [25, 27]. Furthermore, its validity [28] and comparability with facial electromyography results [29] have been confirmed. In Experiment 1, two metrics were used: overall engagement and valence.

2.1.5. Ethical Approval and Informed Consent

The study protocol was approved by the Ethics Review Committee on Research with Human Subjects at Waseda University (approval number: 2021-136). Informed consent was obtained from all participants and models for stimuli, which stated that participation in the experiment was of their own free will, all data on the experiment were kept separate from their personal information, their privacy was protected, and they could cease participation and withdraw their data at any time during or after the study. After the experiment, they were debriefed, asked whether they had any questions, provided a copy of the consent form, and given a final opportunity to withdraw their data.

2.2. Results

2.2.1. Difference in Models' Facial Expressions, as Analyzed by the Kokoro Sensor

Differences between groups were analyzed using analysis of variance (ANOVA), followed by the Ryan-Einot-Gabriel-Welsch and Quiot post-hoc multiple comparison test. A two-factor mixed ANOVA (video context [within stimulus models; i.e., self-introduction video, non-emotional] × stimulus model sex [between stimulus models]) was performed with the dependent variables being engagement and valence of the facial expressions, as analyzed by the Kokoro Sensor.

The analysis revealed a significant main effect of video context: $F(1, 31) = 21.24$, $p < .001$, $\eta^2 = 0.3012$. No significant main effect was found for stimulus model sex: $F(1, 31) = 0.64$, $p = 0.4372$, $\eta^2 = 0.0212$. Additionally, the interaction between video context and stimulus model sex was not significant: $F(1, 31) = 1.03$, $p = 0.3275$, $\eta^2 = 0.0146$ (Figure 1).

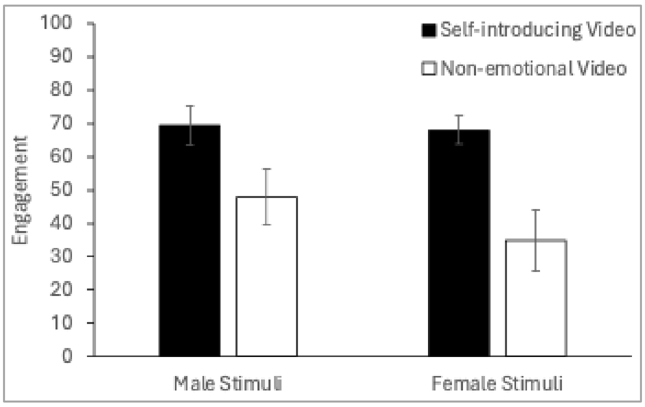

Figure 1. *Mean engagement rating analyzed by the Kokoro Sensor. Error bars show standard errors of the mean.*

Regarding valence, the analysis revealed a significant main effect of video context: $F(1, 31) = 12.72$, $p = 0.0031$, $\eta^2 = 0.2839$. However, no significant main effect was found for stimulus model sex: $F(1, 31) = 0.67$, $p = 0.4259$, $\eta^2 = 0.0178$. Additionally, the interaction between video context and stimulus model sex was not significant: $F(1, 31) = 0.65$, $p = 0.4338$, $\eta^2 = 0.0145$ (Figure 2).

Thus, facial expressions were found to vary depending on the experimenter's control of the facial expressions.

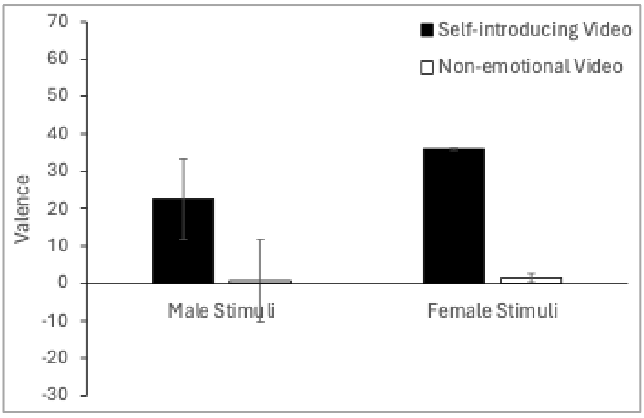

Figure 2. *Mean valence expression analyzed by the Kokoro Sensor. Error bars show standard errors of the mean.*

2.2.2. Difference in Models' Facial Expressions, as Judged by Raters

The perceived positivity of the models' facial expressions was rated and averaged across the four conditions: stimulus model sex (male and female) × video context (emotional video and non-emotional video), and the averaged data were used for analysis.

We conducted a three-factor mixed ANOVA (video context [within participants: emotional video and non-emotional video] × rater sex [between participants] × stimulus model sex [within participants]) to examine whether video context, rater sex, or stimulus model sex affected the ratings and whether there was a significant interaction between these factors. The main effect of the video context was significant: $F(1, 60) = 222.56$, $\eta^2 = .52$, $p < .001$. Evaluations of emotional videos revealed a perception of a more positive expression than that of non-emotional videos. The main effect of the stimulus model sex was also significant: $F(1, 60) = 108.92$, $\eta^2 = .065$, $p < .001$. Female stimulus models were rated more positively than their male counterparts. However, rater sex was not significant: $F(1, 60) = 1.63$, $\eta^2 = .0046$, $p = .21$. There was a significant interaction between video context and stimulus model sex: $F(1, 60) = 48.81$, $\eta^2 = .029$, $p < .001$. A simple main effect was found for stimulus model sex for both male, $F(1, 120) = 103.71$, $p < .001$, and female stimulus models, $F(1, 120) = 271.15$, $p < .001$. The other two-way interaction effects were not significant (between video context and rater sex: F [1, 60] = 0.45, $p = .50$; between rater sex and stimulus model sex: F [1, 60] = 0.01, $p = .93$). The three-way interaction effect was also not significant: $F(1, 60) = 1.44$, $p = .23$ (Figure 3).

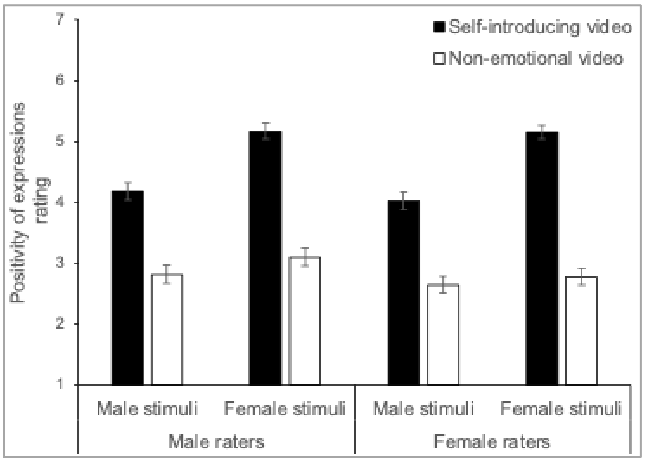

Figure 3. *Mean emotional expression rating rated by participants. Error bars show standard errors of the mean.*

2.2.3. Difference in Models' Attractiveness, as Judged by Raters

The attractiveness evaluations for each participant were averaged across four conditions: stimulus model sex (male and female) × video context (emotional video and non-emotional video). The resulting averaged data were used for analysis.

To investigate whether video context, rater sex, or stimulus model sex affected the attractiveness ratings and whether there was a significant interaction between these factors, we conducted a three-factor mixed ANOVA (video context [within participants; emotional video, non-emotional] × rater sex [between participants] × stimulus model sex [within participants]). The main effect of the video context was significant: $F(1, 60) = 91.81$, $\eta^2 = .20$, $p < .001$; evaluations of emotional videos were more attractive than non-emotional videos. The main effect of the stimulus model sex was also significant: $F(1, 60) = 145.70$, $\eta^2 = .17$, $p < .001$; female stimulus models were rated as more attractive than male stimulus models. However, rater sex was not significant: $F(1, 60) = 0.002$, $\eta^2 = .004$, $p = .96$. The interaction effect between video context and stimulus model sex was significant, $F(1, 60) = 18.15$, $\eta^2 = .015$, $p < .001$, and there was a simple main effect for stimulus model sex for both male, $F(1, 120) = 34.20$, $p < .001$, and female models, $F(1, 120) = 107.75$, $p < .001$); that is, emotional videos were perceived to be more attractive than non-emotional videos for both male and female models. The other two-way interaction effects were not significant (between video context and rater sex: F [1, 60] = 0.00, $\eta^2 = .00$, $p = .98$; between rater sex and stimulus model sex: F [1, 60] = 2.76, $\eta^2 = .000$, $p = .10$). The three-way interaction effect was significant: $F(1, 60) = 6.51$, $\eta^2 = .006$, $p = .013$. The simple main effect of video context was significant for all combinations of rater sex and stimulus model sex. This showed that, regardless of the sex of the rater or stimulus model, emotional videos were rated as significantly more attractive than non-emotional videos (male rater and male stimulus model: F [1, 120] = 25.84, p < .001; male rater and female stimulus model: F [1, 120] = 40.56, p < .001; female rater and male stimulus model: F [1, 120] = 10.16, p = .002; female rater and female stimulus model: F [1, 120] = 69.01, p < .001) (Figure 4).

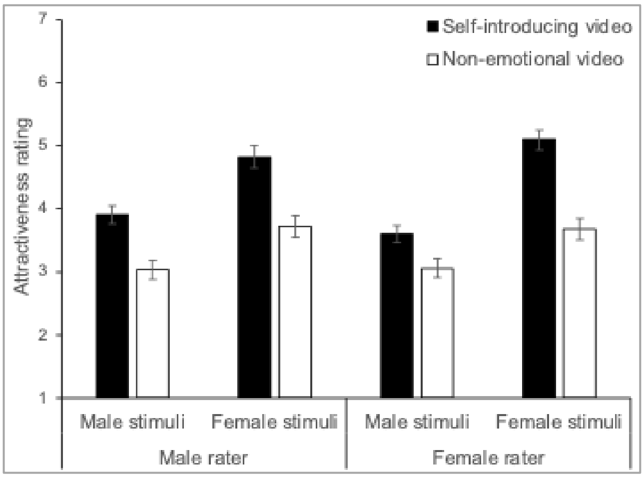

Figure 4. *Mean attractiveness rating rated by participants. Error bars show standard errors of the mean.*

The results of Experiment 1 showed that the positivity and richness of facial expressions evaluated by the facial expression analysis software changed with the experimenter's control. The positivity of facial expressions from raters also changed, and the attractiveness evaluation changed accordingly. People are more likely to smile in social situations, such as talking to others or meeting with friends than in solitary situations [30-32]. Considering the results of the present study from the viewpoint of situations in which smiles are likely to occur, we can conclude that an individual's tendency to smile naturally increases when videos are shot in social situations, such as self-introductions, than in nonsocial situations, such as reading numbers, wherein there is no interpersonal interaction. While Experiment 1 demonstrated that facial expressions affected attractiveness ratings across stimuli, Experiment 2 examined the association between positive facial expressions and attractiveness ratings across stimulus models expressing facial expressions.

3. Experiment 2

In Experiment 2, we examined the relationship between facial expressions and attractiveness using self-introduction videos, in which facial expressions were found to be more richly expressed than in the case of the non-emotional control group. This experiment examined the possibility that perceivers' unconscious evaluation of attractiveness affected their conscious evaluation of facial expressions. The purpose was to investigate whether there is a relationship between attractiveness and subjective facial expression valence (evaluated by people) as well as between attractiveness and objective facial expression valence (evaluated using software). Furthermore, this experiment aimed to verify whether naturally expressed facial expressions influence attractiveness ratings.

Although the data from Experiment 1 could be used to validate the present objective, as this experiment targeted the facial expressions and attractiveness ratings between stimulus models, 67 stimulus models were added to the existing 16 in Experiment 1; thus, data from 83 stimulus models were used for Experiment 2.

3.1. Methods

3.1.1. Participants

We recruited 198 Japanese undergraduate students (76 male, 122 female; mean age = 20.73 years, SD = 1.79, age range: 18–25 years) as raters. They were recruited from the Tokorozawa Campus of Waseda University. The participants were healthy Japanese undergraduates with normal vision and no history of taking psychedelic medication.

3.1.2. Stimuli

For this experiment, 83 Japanese undergraduate and graduate students (43 male, 40 female; mean age = 21.23 years, SD = 1.67), including the 16 students from Experiment 1 and 67 newly recruited students (35 male, 32 female; mean age = 21.16 years, SD = 1.74, age range: 18–25 years), served as stimuli models. They were recruited from the Waseda campus of Waseda University and were not acquainted with any of the raters.

The video in which the stimulus models introduced themselves was filmed in the same method as in Experiment 1 (self-introduction video).

The reason for choosing to study self-introduction videos is that it is a common scene in daily life and is likely to generate individual differences in emotional valence. In Experiment 1, the self-introduction videos were found to have higher engagement values and richer facial expressions, making them suitable for examining the types of facial expressions that affect attractiveness.

3.1.3. Evaluations

The raters were divided into two groups: an attractiveness rating group (102 raters; 40 male and 56 female) and an expression rating group (96 raters; 36 male and 66 female) to avoid making explicit conscious judgments of both attributes. The effect of fatigue was considered, and the participants rated the attractiveness or facial expressions of 20 of the prepared 83 stimuli. Thus, each stimulus was rated for attractiveness or facial expression by 20–25 raters.

Participants were asked to watch a 10-second video stimulus. When the video finished playing, the attractiveness rating group rated the attractiveness, and the facial expression rating group rated the facial expression of the person in the video on a 7-point scale (1 = not at all attractive/very negative, 7 = very attractive/very positive). Once the participants had rated one video, another was presented. The order of presentation of the stimuli was randomized and counterbalanced between participants. No time limit was set for the evaluation of a video.

For facial expression analysis, we used the emotion recognition software Kokoro Sensor, developed by CAC Co. In Experiment 2, the valence values were analyzed using the Kokoro Sensor. The valence value is a rating of the positivity of facial expressions on a scale of -100 (negative) to +100 (positive).

3.2. Results and Discussion

We examined the association between attractiveness ratings and subjective ratings of facial expressions by raters (expressivity), which may be affected by attractiveness, and the association between attractiveness ratings and objective facial expression ratings using the Kokoro Sensor, which is not influenced by attractiveness. Pearson's correlations were computed for the associations for each sex, and *p*-values of less than 0.05 were considered statistically significant. As shown in Table 1, the attractiveness ratings were correlated with the raters' expressivity ratings ($r = .79$, $p < .001$) and the expressivity valence measured by the Kokoro Sensor ($r = .47$, $p < .001$). Additionally, the expressivity rating correlated with the expressivity valence measured using the Kokoro Sensor ($r = .65$, $p < .001$) (Table 1).

Table 1. *Correlations between attractiveness and expression ratings of all stimuli faces.*

	Expressivity rated by raters	**Valence rated by the Kokoro Sensor**
Attractiveness rated by raters	.79**	.47**
Expressivity rated by raters		.65**

*** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .10$

We also conducted correlation analyses for both male and female stimulus models. For both, the attractiveness rating was correlated with the expressivity rating by the rater (male: $r = .75$, $p < .001$; female: $r = .75$, $p < .001$) and the expressivity valence measured by the Kokoro Sensor (male: $r = .47$, $p < .001$; female: $r = .30$, $p = .03$). Additionally, the expressivity rating correlated with the expressivity valence measured by the Kokoro Sensor for both male and female stimuli (male: $r = .64$, $p < .001$, female: $r = .57$, $p < .001$) (Tables 2 and 3).

Table 2. *Correlations between attractiveness and expression ratings of male stimuli models.*

	Expressivity rated by raters	**Valence rated by the Kokoro Sensor**
Attractiveness rated by raters	.75**	.47**
Expressivity rated by raters		.64**

*** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .10$

Table 3. *Correlations between attractiveness and expression ratings of female stimuli models.*

	Expressivity rated by raters	**Valence rated by the Kokoro Sensor**
Attractiveness rated by raters	.75**	.30+
Expressivity rated by raters		.57**

*** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .10$

The results of Experiment 2 revealed that, for both male and female faces, attractiveness was positively correlated not only with subjective facial positivity by those potentially affected by attractiveness but also with facial positivity, as assessed objectively by facial expression analysis software. Previous studies have consistently shown that facial expressions significantly influence perceived attractiveness. Happy expressions generally enhance attractiveness, with smiling faces rated as being more attractive than neutral or sad faces [33-35]. Additionally, happy expressions may compensate for their relative unattractiveness [33]. Considering the results of Experiment 2 in light of previous studies, we can conclude that actual facial expressions positively affect attractiveness perception.

4. General Discussion

This study examined the influence of facial expressions on attractiveness ratings, overcoming the problems of previous studies that have examined the relationship between the two. This study examined the relationship between facial expressions and attractiveness by increasing the relevance of facial expressions and the lack of movement owing to the use of static images in everyday life by using videos. Furthermore, a unique feature of this study is the use of facial expression analysis software to examine the relationship between facial expressions and attractiveness. The facial expression analysis software enabled us to examine videos of natural facial expressions objectively. Experiment 1 examined the effects of the experimenter's control over the stimulus model on the model's facial expressions and attractiveness ratings. Experiment 2 examined the relationship between facial expressions and attractiveness.

Previous studies using dynamic images have not examined whether the content and control methods of moving images affect facial expressions or attractiveness ratings [14, 20]. Experiment 1, therefore, examined the relationship between facial expressions and attractiveness ratings using video recordings and found that facial expressions and attractiveness ratings changed depending on the experimenter's control procedure during the video recording.

Specifically, in Experiment 1, the experimenter shot videos in which the stimulus model was given two types of instructions regarding facial expressions by the experimenter and investigated whether differences in the instruction caused differences in both the subjective (assessed by the participants) and objective (analyzed using software) facial expression ratings. Furthermore, we investigated whether the experimenter's control of facial expressions caused differences in the raters' attractiveness ratings.

The data from Experiment 1 showed that the emotion recognition software indicated that the facial expressions in the self-introduction/emotional videos expressed more positive emotions and facial expressiveness as the models introduced themselves more freely with natural facial expressions than in the non-emotional videos. Correspondingly, participants rated emotional videos as having more positive facial expressions. Additionally, emotional videos were rated as more attractive than non-emotional videos in the attractiveness evaluation.

The dynamic information in a video may bring out the naturalness and diversity of facial expressions, which may play an important role in evaluating attractiveness. As the experimenter's method of control has a significant influence on the results, standardization and unification of stimulus control methods are required in future studies dealing with human impressions.

Regarding the evaluation of facial expressions, the degree of positive facial expressions was higher in the emotional videos than in the non-emotional videos. This is because the emotional videos were in a social context with an awareness of the interpersonal situation. Several studies have found that individuals smile more frequently when socially engaged, such as during conversations or when meeting friends, than when alone [30-32]. Lee et al. [36] showed that prototypically neutral faces may be evaluated negatively in certain situations. Furthermore, neutral faces, such as non-emotional faces, tend to be rated as sad compared with happy faces [37]. Thus, the present study supports the results of Russell and Fehr [37], indicating that non-emotional video expressions may be evaluated more negatively.

Regarding attractiveness ratings, the only difference between the two videos in this experiment was facial expression control, because the stimulus models in the two videos were the same person. Therefore, we can conclude that the difference in attractiveness ratings was due to differences in facial expression control. These results indicate that attractiveness ratings were significantly changed by controlling for facial expressions. Thus, we found differences in facial expressions in our statistical analyses and objective and subjective evaluations, by placing a control on facial expressions; furthermore, the attractiveness ratings also differed. In a previous study that examined the difference in attractiveness between static and moving images, changes in attractiveness ratings were examined with and without movement without emphasizing on control of facial expressions [20]. The current study is unique as it questions the validity of impression perception research by showing that statistical changes in facial expressions and attractiveness should be considered when using moving images.

In Experiment 2, we examined whether there was a relationship between attractiveness and facial expressions that were expressed, using the data on expressivity as analyzed by the software. Data from Experiment 2 revealed that for both men and women, not only the positivity of facial expressions, as rated by people, but also the positivity of the actual expressions, as analyzed by the software, were positively correlated with attractiveness ratings. Previous studies have examined the effect of facial expressions on attractiveness by using unnatural facial expression stimuli acted out in static pictures [7-9]. By contrast, the experiment in the present study showed that different facial expressions in naturally expressed moving images affect attractiveness.

When combined with data from Experiment 1, the fact that software-based ratings of facial expression positivity matched human ratings implies that the relationship between facial expressions and attractiveness can be objectively assessed. In other words, these results indicate that actual facial expressions are a factor in facial attractiveness; further, they support the possibility that positive facial expressions give people an impression of attractiveness. Previous studies have shown that smiling faces are rated as more attractive than neutral faces [8, 9], and happy faces are rated as the most attractive among the six prototypical facial expressions: neutrality, sadness, disgust, fear, anger, and happiness [7]. This may be because positive expressions generate a positive affective response in the rater, who may then see the other person as more attractive [7].

A possible reason for the association between positive facial expressions and attractiveness is that, from an evolutionary perspective, people may find physical health in facial expressions and instinctively judge people with positive facial expressions as more attractive to ensure better offspring. Positive facial expressions are often associated with physical and mental health; for example, a group that undertook a program comprising smiling and exercising had higher bone density [38], lower depression scores, and higher life satisfaction than the control group [38, 39]. Furthermore, facial expressions may serve as adaptive signals, conveying traits such as emotional stability, cooperative intent, and social compatibility, which are advantageous for mate selection and group cohesion [40]. These signals may play a critical role in fostering trust and collaboration within social groups, thereby enhancing survival and reproductive success.

Another explanation for the association between positive facial expressions and attractiveness is that individuals with inherently attractive features, such as averageness and symmetry, tend to develop positive facial expressions due to favorable social treatment, reinforcing acquired attractiveness. Langlois et al. [41] demonstrated that facial attractiveness is consistently linked to better interpersonal relationships and positive treatment, which evolutionarily supports the development of more positive facial expressions. Conversely, individuals with less attractive features may experience more negative interpersonal interactions, potentially leading to less positive expressions over time. This dual mechanism—where innate attractiveness promotes positive expressions, and these expressions serve as evolutionarily significant signals of fitness—provides a comprehensive explanation of the intricate link between facial expressions and attractiveness.

Rennels and Kayl [42] examined the relationship between facial expressions and attractiveness using a design that separated the evaluation of facial expressions from full-face attractiveness ratings. They found a positive association between the positivity of mouth-only expressions and full-face attractiveness for female faces but not for male faces. In contrast, our study uncovered a positive correlation between facial expression positivity and attractiveness for both male and female faces. The discrepancy between these findings may be attributed to differences in the methods used to measure expression valence. Rennels and Kayl [42] relied on mouth-only expressions as a proxy for objective valence and acknowledged this as a limitation, demonstrating that non-human methods, such as computer-automated analysis, could provide a more reliable assessment. Our study addressed this limitation by using automated expression analysis, enhancing the validity of the findings and revealing a broader association between facial positivity and attractiveness.

From a psychological perspective, this study underscores the dynamic and impactful role of facial expressions in shaping interpersonal impressions and guiding social interactions. Positive facial expressions not only enhance perceived attractiveness but also influence judgments of trustworthiness, competence, and approachability, as evidenced in prior research [43]. These findings deepen our understanding of nonverbal communication mechanisms and highlight the potential for interventions targeting emotional expressivity.

For individuals with body dysmorphic concerns, who often fixate on immutable structural facial features and consequently experience significant distress [44, 45], the modifiable nature of facial expressions offers a promising focus for therapeutic strategies. Unlike structural traits, facial expressions can be consciously adjusted and enhanced through training, offering a sense of agency and control that may mitigate negative self-perceptions. For example, interventions designed to cultivate positive emotional expressivity, such as guided smiling exercises or emotion-focused cognitive behavioral therapy, could not only improve perceived attractiveness but also foster more fulfilling interpersonal experiences [24, 46, 47].

The social reinforcement of positive facial expressions may further contribute to psychological well-being, creating a virtuous cycle where improved interpersonal interactions bolster self-esteem and reduce fixation on perceived flaws. Future research should investigate the efficacy of targeted programs that integrate emotional expressivity training and social skills enhancement, particularly for populations with body-image concerns. Such programs could bridge the gap between psychological resilience, social functioning, and overall well-being, offering transformative support for those navigating the challenges of body dysmorphic concerns.

This study demonstrates the potential of AI-based emotion recognition systems, such as Affectiva's "Kokoro Sensor," in understanding dynamic facial expressions and their impact on interpersonal perceptions. By aligning human and AI assessments of emotional positivity, the findings highlight the applicability of these technologies in education, healthcare, and customer service settings. However, their success depends on refining methodologies to address challenges such as dataset diversity and cultural adaptability.

Although the investigated software incorporates diverse inputs, no dataset fully represents the breadth of human diversity. Research shows that even well-curated datasets may underrepresent specific demographics, leading to biases in emotion detection [48, 49]. Cultural differences further complicate generalizability. For instance, Japanese individuals tend to express emotions more subtly than Western counterparts, where expressions are often more overt [50, 51]. These findings are consistent with broader research demonstrating cross-cultural variations in both the production and perception of facial expressions [52, 53]. Such differences underscore the importance of using culturally relevant datasets to improve AI models' accuracy and relevance.

While this study provides valuable insights, its reliance on Japanese students limits the generalizability of its findings. Demographic factors such as age and cultural background also influence facial expression production and perception. For example, older individuals show age-related changes in expression dynamics, while cultural norms shape emotional expression and interpretation [40, 54]. Research further suggests that cultural-specific mechanisms, such as cognitive strategies used to interpret emotions, play a significant role in shaping perceptions across different populations [53]. Expanding research to include diverse age groups and cultural contexts will offer a more comprehensive understanding of these interactions.

Future efforts should focus on tailoring datasets to specific cultural contexts and expanding representation across underrepresented groups. Addressing these challenges will enable the development of culturally adaptive and contextually accurate emotion recognition systems, ensuring fairness and reliability across various applications.

5. Conclusions

This study aimed to investigate the influence of dynamic facial expressions on perceived attractiveness while addressing limitations in prior research, such as the reliance on static images and limited exploration of the interplay between structural and dynamic features. By employing both human evaluations and AI-based emotion recognition, we sought to clarify the role of facial expressions in shaping perceptions of attractiveness.

This study demonstrates that experimenter control over facial expressions in videos influences both the expressions displayed by stimulus models and attractiveness ratings given by observers. The critical role of facial expression positivity, independent of innate attractiveness, in shaping perceptions of attractiveness is highlighted. By addressing limitations in prior research, this study validates that modifiable factors, such as facial expressions, significantly impact attractiveness. These insights advance our understanding of facial perception and interpersonal impressions, demonstrating that attractiveness is influenced not only by structural features but also by dynamic, consciously changeable behaviors.

Future research may explore several promising areas based on these findings. First, examining the impact of cultural and social norms on the relationship between facial expressions and attractiveness would deepen our understanding of cross-cultural differences in emotional and aesthetic evaluations. Second, longitudinal studies could investigate how repeated exposure to specific facial expressions influences perceived attractiveness over time, particularly in real-world social interactions. Additionally, exploring the interplay between innate attractiveness and acquired behaviors, such as facial expressions, could provide new insights into how social experiences shape perceptions of beauty. Finally, testing the ecological validity of these findings in everyday environments would bridge the gap between controlled laboratory settings and real-world applications, particularly in fields such as education and healthcare. These recommendations not only address the limitations of the current study but also provide a foundation for advancing research in facial attractiveness, emotional expression, and human interaction.

Abbreviations

AI	Artificial Intelligence
ANOVA	Analysis of Variance
AU	Action Units
FACS	Facial Action Coding System

Acknowledgments

We thank Kenji Tomita for excellent experimental support.

Author Contributions

Mayu Yamaguchi: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Kazuhiro Ikeda: Methodology, Writing – review & editing.

Yayoi Kawasaki: Formal Analysis, Methodology, Writing – review & editing.

Eriko Sugimori: Conceptualization, Formal Analysis, Methodology, Writing – review & editing, Supervision

Funding

This work is supported by JST SPRING (Grant No. JPMJSP2128).

Data Availability Statement

The data are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that this study was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

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