

## Research Article

UDC 159.9

<https://doi.org/10.21702/rpj.2022.2.1>

# Gender Factor in Recognizing the Emotional State of a Person by His Audio-video Images

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**Annotation : Introduction** . Gender differences in the perception of human emotional states are usually studied on the material of static images of the face, gestures or postures. The dynamics and multiplicity of manifestations of emotions remain behind the scenes. The proposed work is aimed at finding patterns of perception of the procedural characteristics of the expression of emotions. The influence of gender and age on the identification of emotional states in ecologically and socially valid situations is investigated. **Methodology** . It is based on the Russian version of the Geneva Emotion Recognition Test (Geneva emotion Recognition Test , GERT). The subjects, 48 women and 48 men, aged 20 to 62, were randomly presented with 83 audio-video clips recording fourteen key emotional states. Along with facial expressions, gestures, movements of the head and eyes, changes in the position of the body, the actors voiced pseudo-linguistic statements containing expressive intonations. An abbreviated version of the Geneva Wheel of Emotions was used as a tool for assessing emotional states. Each video clip was shown to the observer for 3–5 s. Gender differences in the responses in the accuracy of identification and the categorical structure of the tested expressions were determined. **Discussion** . Women, compared with men, more accurately recognize multimodal dynamic emotions, especially those expressed by women. Men are more sensitive to the nuances and semitones of the states they demonstrate. Sex and age differences in identification accuracy are statistically significant for five emotions: joy, amusement, irritation, anger, and surprise. On women's faces, joy, surprise, irritation and anger are more accurately recognized by women after 35 years. On male faces, surprise is less accurately recognized by men under 35; entertainment, irritation, anger - after 35 years. The dependence of the accuracy of recognition of multimodal dynamic expressions of emotions on the degree of arousal in male observers was not found, in women it is multidirectional, determined by the modality of emotion, the sex of the actor and the age of the observer.

**Keywords:** geneva emotion recognition test, human face, gender, age, gender differences, emotion modality, multimodal dynamic states, perception of expressions, emotion recognition, categorization

## Highlights

- the gender factor does affect the recognition of multimodal dynamic expressions; the influence of the gender factor is selective and depends on a specific combination of conditions: gender characteristics of the subject and object of perception, the age of observers, ways of expressing emotions, etc.;
- differences in the recognition of a "live" face by representatives of different sexes are manifested not only in the accuracy of observers' assessments, but also in the structure of categorical fields; dependence of the accuracy of identification of multimodal emotional states on the degree of arousal is manifested only in the female sample and, depending on age, is multidirectional;
- gender factor in the perception of multimodal expressions of the state of people acts as a system of determinants that changes its characteristics depending on a specific communicative situation.

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**Funding:** The study was supported by the Russian Science Foundation, project No. 18-18-00350-P "Perception in the structure of non-verbal communication."

## For citation

Barabanshchikov, V.A., Suvorova, E.V. (2022). Gender factor in recognizing the emotional state of a person by his audio-video images. *Russian psychological journal*, 19 (2), 6–20. <https://doi.org/10.21702/rpj.2022.2.1>

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## Introduction

Gender differences, or divergence of signs that characterize men and women in the expression and perception of the emotional state of people, are based on both biological and sociocultural reasons. The ideas of masculinity and femininity accepted in society, as well as the rules of upbringing, largely determine the form of expression of emotional states. Men more often suppress their emotions, women, on the contrary, show them more openly, actively use facial expressions, gestures, postures, and speech; women's emotions are longer and more intense than men's (Phillips, Slessor, 2011). Women more accurately express experiences of joy, sadness, disgust, contempt and fear, and men - anger, surprise, contempt and joy. In general, women are slightly more accurate than men in both expressing and recognizing emotional states (Graham, Denson, Barnett, Calderwood, Grisham, 2018; Hall, 1978). The difference in the accuracy of expression recognition, confirmed by statistical criteria, is less common and depends on the modality, method and context of expressing emotions, individual characteristics of the participants in interpersonal interaction. Sexual dimorphism in the expression and recognition of emotions develops with age and interacts with sociocultural factors, ultimately determining emotional behavior (Brody and Hall, 2013). With increasing age, the accuracy of recognition of facial expressions decreases, with women recognizing emotions more accurately than men. The most noticeable decrease in the accuracy of identifications occurs after the age of 65 (Schlegel, Scherer, 2016), affecting the emotions of anger, sadness, and fear (Chaplin, Aldao, 2013; Fischer, Manstead, 2000).

Most of the experimental studies of the topic under discussion were carried out on the basis of assessments of photographic images of facial expressions, gestures or poses of sitters. To date, a more complete analysis of the gender characteristics of interpersonal perception is required, taking into account the multidimensionality and dynamics of the expression of a person's emotional

states in the real process of communication. The focus is on a "live" person, included in a specific communicative situation. In contrast to the factors that determine the unimodal expressions of "frozen" images, changes in facial expressions, eye movements and contact, articulation, head shaking, gestures, voice intonations, becoming a complex independent whole, become important. The expression of emotions is described in terms of action - human activity, which constitutes the interpersonal situation and regulates the flow of subject-subject interactions. This implies a significant expansion of the information base of the perceptual process, the use of appropriate strategies and mechanisms for categorizing emotional states (Drums, Korolkova, 2020; Drums, Korolkova, Lobodinskaya, 2018; Drums, Marinova, 2021; Drums, Marinova, Abramov, 2021). New ways of studying the patterns of cognition, experience and communication are opening up.

This article is devoted to the role of the gender factor in recognizing the emotional states of people in ecologically and socially valid conditions. The experimental study is based on the GERT method (Geneva emotion Recognition Test), which has proven itself well in a number of foreign studies (Dael, Mortillaro, Scherer, 2012; Schlegel, Grandjean, Scherer, 2012, 2014; Schlegel, Scherer, 2017, 2018) and tested on a Russian sample (Darabanshchikov, Suvorova, 2020a, b). This is one of the few techniques that allows you to effectively study and diagnose the specifics of the perception of multimodal dynamic expressions that quite fully reproduce the expressions of human emotions in everyday life. The specific goal of the study is to, based on the GERT methodology, study the ways and conditions of the influence of the gender factor on the recognition of a person's emotional state by his audio and video images.

We have tried to answer a number of questions. Are there gender differences in recognition accuracy and categorical fields of multimodal dynamic expressions? If they do, how? To what extent do assessments of multimodal emotional states depend on the sex of the sitters and the age of the observers? Can gender be seen as a precondition for better performance in emotion identification tasks in ecologically and socially valid situations?

## Method

GERT is based on the "Geneva Wheel of Emotions", a conceptual construct that connects a set of 14 key categories of emotions into a circle, ordered by valence and degree of excitation (activation) (Russell, 1983; Scherer, 2005; Schlegel, Grandjean, Scherer, 2014). The visualized structure of the construct is shown in Figure 1. It includes 4 affective associations and three separate emotions.

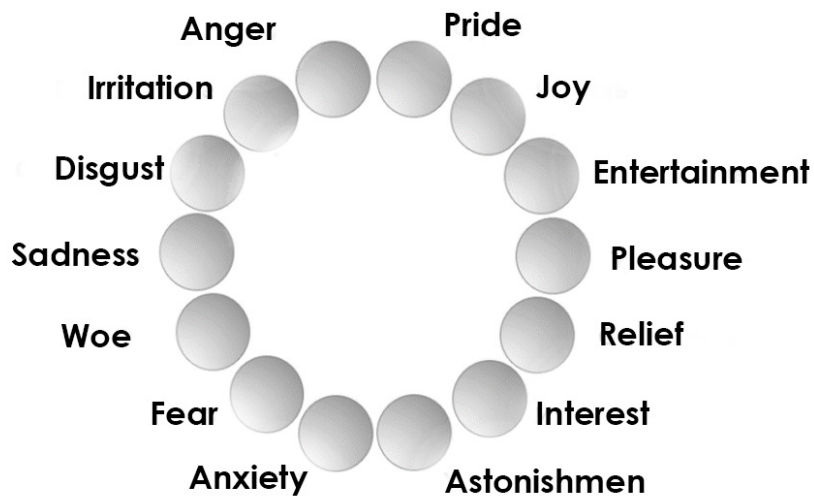
Pride, entertainment, joy, pleasure and relief form a group of states with positive valence (group A); it includes various forms of manifestation of human achievements, which are often observed in social situations. In affective groups of states with negative valence B, C and D, the same type of emotions are divided according to the degree of excitation. Affective group B includes anxiety and fear; group C - sadness and grief; group D - irritation and anger. Disgust, as well as ambivalent interest and surprise, are considered as independent states.

The experiment used the Russian version of GERT (Barabanshchikov, Suvorova, 2020a,b), which retained the original stimulus material, the procedure for evaluating audio-video images, and the set of requirements (Bänziger, Mortillaro, Scherer, 2012). The study was conducted in a remote form on the LimeSurvey electronic platform, where a technical copy of the experiment was created using the Russian version.

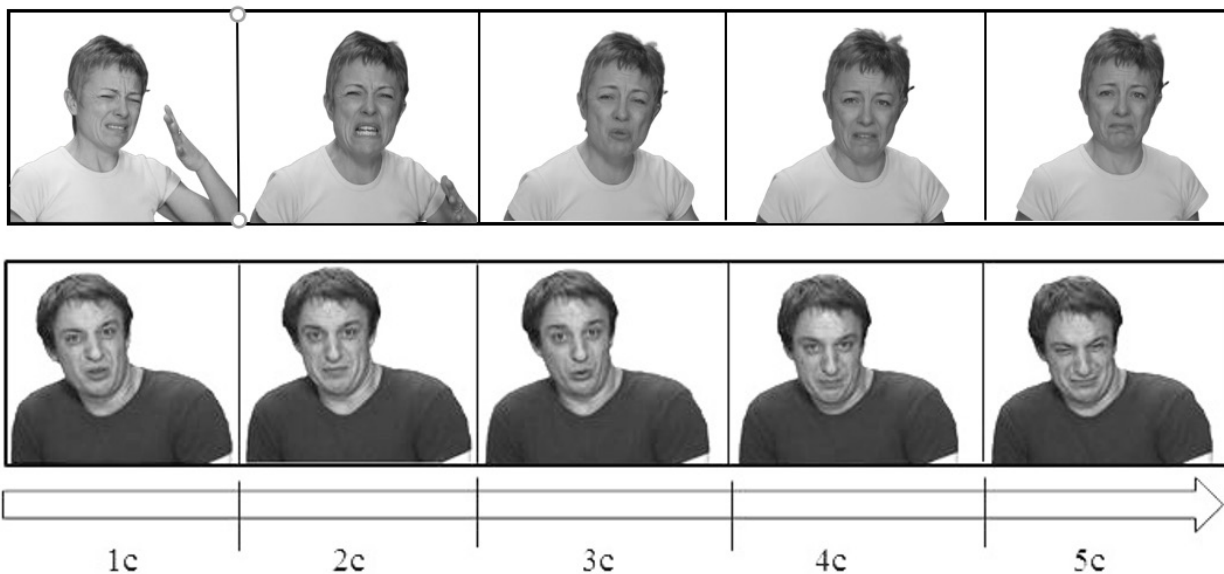
83 audio-video clips of emotional states posed by 10 professional specially trained actors (5 men and 5 women) were used as stimulus material. The average age of sitters is 37 years. Along

with facial expressions, gestures, movements of the head and eyes, changes in body position, the actors voiced pseudo -linguistic statements containing expressive intonations. Examples of stimulus material made in a discrete form are shown in Fig. 2. The angular size of the video image is  $18 \times 24^\circ$ , the sitter's face is  $8 \times 10^\circ$ .

**Figure 1.** "Geneva wheel of emotions": Russian version (Barabanshchikov, Suvorova, 2020b)



**Figure 2.** A video storyboard of an expression of disgust presented by an actress and an actor. The interval between frames is about 1s.



Participants were emailed instructions for completing the study, equipment requirements (earphones and a 1920x1080px display located 60 cm away from the subject's face) and URL links providing access to the experiment.

At the first stage of the study, the participants got acquainted with the instructions, which included recommendations, technical features of the experiment and the definition of the tested emotional states. After completing the training tasks (3 audio-video images), the participant had the opportunity to return to the instructions again.

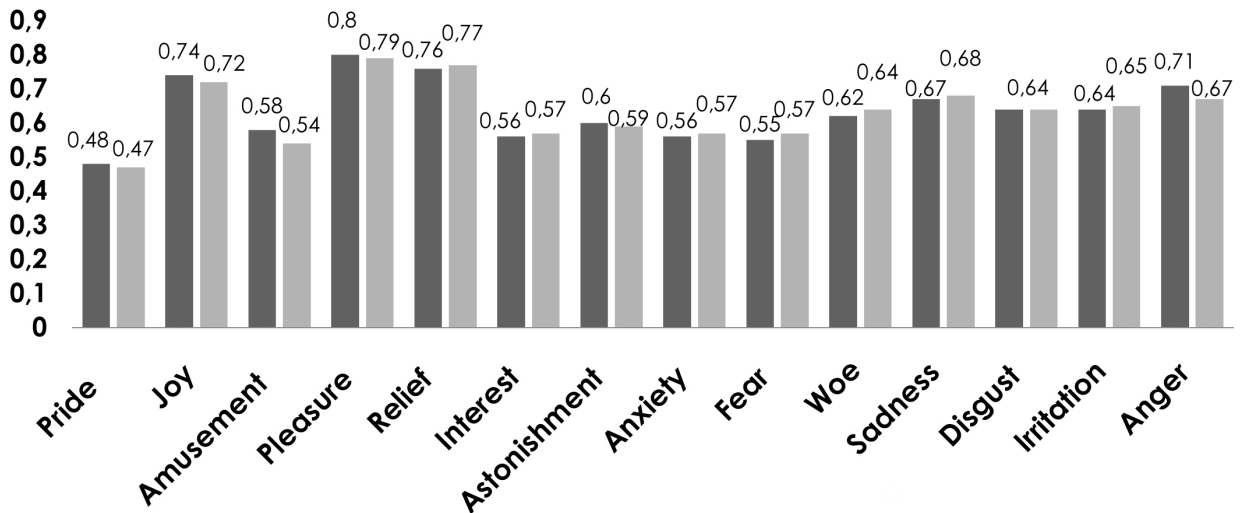
At the second stage, the subjects were sequentially, in random order, presented with 83 audio-video images of emotional expressions. Each exposure was shown once for 3–5 s without the possibility of repetition. As a tool for assessing multimodal expressions, interactive conditional images of 14 emotions were used, presented on the display in a circle in the order specified by the chosen method. The "Wheel of Emotions" was presented after the exposure of each expression, with the technical possibility of choosing only one of the affective categories. After selecting a category and touching the corresponding circle on the screen, the transition to the next exposure was carried out automatically. The study program was completed by displaying on the screen the average result of recognition accuracy obtained by the participant.

The averaged indicators of recognition of multimodal expressions were analyzed for all audio-video images, the data were compared, divided into groups depending on the gender of the actor and the observer, taking into account the age of the latter. An analysis of the structure of the categorical field of dynamic expressions was based on averaged relevant and irrelevant estimates of the expressions of each category with a recognition threshold above random ( $> 0.05$ ). For the purposes of statistical analysis, a statistical software package, SPSS 22.0, was used. The following statistical criteria were used: Mann-Whitney U-test and Wilcoxon Z-test with a significance level of  $p < 0.05$ , as well as the concordance coefficient (Kendell's rank correlation) and Spearman's correlation coefficient with a significance level of  $p < 0.01$ .

The sample consisted of undergraduate and graduate students from Russian universities who had previously taken part in a larger study (Barabanshchikov, Suvorova, 2020b) aged 20 to 62 years ( $M = 34$  years,  $SD = 9.4$  years), 48 women, 48 men.

## **Results and discussion**

To correctly address the issue of the role of the gender factor in the recognition of multimodal expressions, we formed a sample of observers balanced by gender and age (sample II). Its representativeness was confirmed by the correspondence of the selected answers to the estimates of a wider, but not balanced sample of subjects who participated in the testing of the Russian version of GERT (sample I). There are no statistically significant differences according to the Mann-Whitney test, concordance coefficients The Kendell (0.87) and Spearman (0.96) correlations highlight the high level of data consistency (Figure 3).



**Figure 3** . Recognition Accuracy of Multimodal Dynamic Expressions Without Sex Differentiation

■- sample I; ■- sample II

It follows that the new sample reproduces the main patterns of perception described by us earlier: (a) functional autonomy of multimodal expressions, (b) differentiation of emotions of affective group A depending on semantic relations and level organization, (c) the absence of a stable linear dependence of recognition accuracy emotions of affective groups B, C, D on the degree of excitation (errausela), (d) the presence of a complex multidimensional structure of categorical fields, (e) the sources of additional components of perceived emotions are intragroup modalities or affective categories of emotions that are close to them in terms of the degree of excitation (Drummers, Suvorova, 2020a,b) .

Summary data of statistically significant gender differences in the accuracy of identification of multimodal emotional states are presented in Table 1. Its analysis allows us to make a number of general statements. First, the gender factor does influence the recognition of multimodal dynamic expressions. Secondly, this influence is selective local in nature and depends on a specific combination of conditions: gender characteristics of the subject and object of perception, the age of observers, ways of expressing emotions, etc. Thirdly, the magnitude of the detected differences varies in a wide range of values, reaching 30–40 % of the median accuracy of emotion recognition. All this suggests that it is far from always possible to ignore the role of the gender factor in experimental or diagnostic work with environmentally valid manifestations of emotions.

With a combined exposure of the states of sitters - both men and women - more accurate answers are given by female observers. The average accuracy of identifications made by women is 0.66, by men – 0.61. Statistically significant gender differences were obtained on the expressions of *entertainment* , *surprise* and *irritation* . Both groups of observers most accurately recognize the emotions of pleasure, relief and joy, the least accurately - pride.

When exposing expressions expressed by male actors, the pattern of responses is largely



preserved. Gender differences are reproduced in ratings of *amusement, surprise, and annoyance*. The average accuracy of identifications made by women is 0.65, by men – 0.59. Deeper changes occur during the exposure of expressions expressed by women. The structure of significant gender differences is radically changing: *pride* takes the place of amusement, surprise and irritation. The general drop in the accuracy of identification in men is accompanied by a trend towards an increase in adequate responses in female observers. The average frequency of accuracy of identifications expressed by women is 0.7, by men - 0.6.

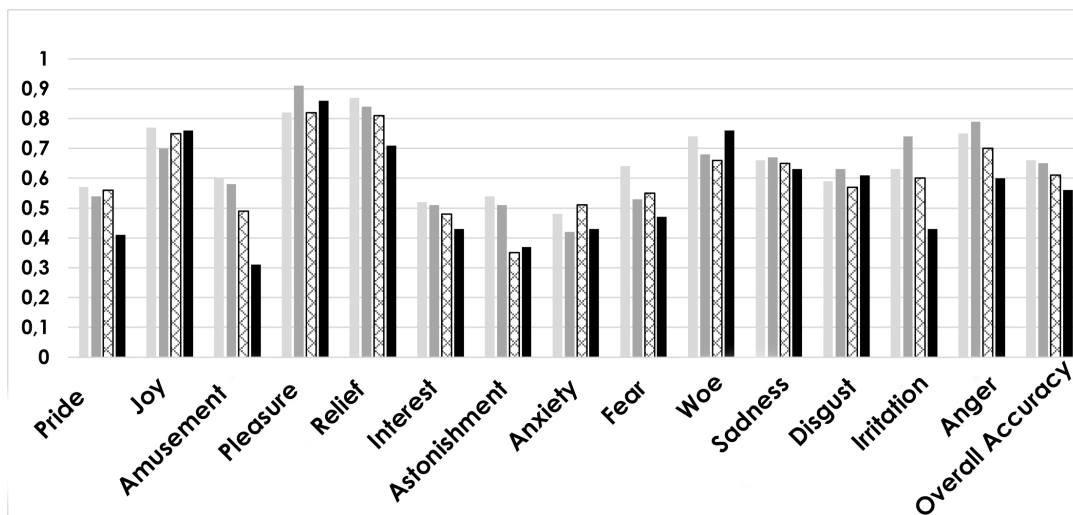
**Table 1**

*Gender and Age Differences in the Perception of Multimodal Dynamic Expressions*

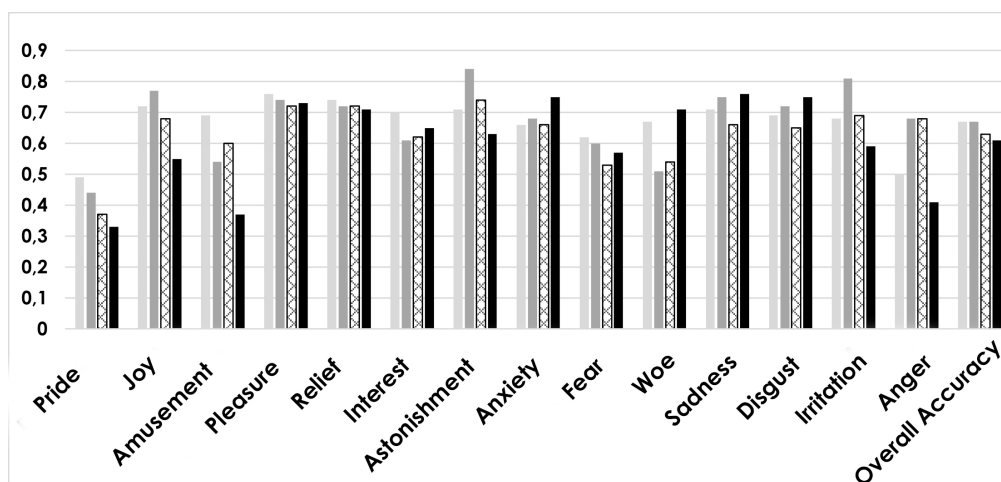
Identification accuracy							
Women better recognize emotions of <i>entertainment</i> (m - 0.48; w - 0.61; U=870, p<0.05), <i>surprise</i> (m - 0.53; w - 0.65; U=781, p<0.05) and <i>irritation</i> (m - 0.6; w - 0.7; U=888.5, p<0.05)							
Gender differences in the recognition of male expressions				Gender differences in the recognition of female expressions			
obtained for the emotions of <i>entertainment</i> (m - 0.43; w - 0.59; U=865.5, p<0.05), <i>surprise</i> (m - 0.36; w - 0.53; U=784, p<0.05) and <i>irritation</i> (m - 0.54; w - 0.67; U=878, p<0.05)				obtained only for the emotion of <i>pride</i> (m - 0.43; w - 0.52; U=888, p<0.05)			
Gender differences in the recognition of male expressions, taking into account the age of the observers				Gender differences in the recognition of female expressions, taking into account the age of the observers			
Women	Men	Women	Men	Women	Men	Women	Men
up to 35		after 35		up to 35		after 35	
men are worse at recognizing the emotion of <i>surprise</i> before the age of 35 (m - 0.35; w - 0.54; U=279.5, p<0.05)		men are worse at recognizing the emotions of <i>entertainment</i> (m - 0.31; w - 0.58; U=92, p<0.05), <i>irritation</i> (m - 0.43; w - 0.74; U=69.5, p<0.05) and <i>anger</i> (m - 0.60; w - 0.79; U=96.5, p<0.05) after 35 years		No		women over 35 better recognize emotions of <i>joy</i> (m - 0.55; w - 0.77; U=98, p<0.05), <i>surprise</i> (m - 0.63; w - 0.84; U=101, 5, p<0.05), <i>irritation</i> (m - 0.59; w - 0.81; U=96, p<0.05) and <i>anger</i> (m - 0.41; w - 0.68; U= 102.5, p<0.05).	

Comparing significant differences in recognition accuracy in three situations: a) the exposure of emotions expressed by a combined group of actors (male + female), b) the exposure of emotions expressed only by male actors, and c) the exposure of emotions represented only by actresses, it is not difficult to come to the conclusion about the importance of gender stylistics of posing emotional multimodal dynamic states and its influence on their identification. The male manner of expressing emotions (exposure of entertainment, surprise and irritation) turns out to be more catchy, deeper, but more adequately read by women.

**Figure 4** . Median assessments of the accuracy of recognition of multimodal dynamic expressions expressed by men (a) and women (b) depending on the sex and age of the observers



a



b

"\*" - statistically significant differences; ■ - responses of female observers under 35; ▨ - responses of male observers under 35; ▩ - responses of female observers after 35 years; ■ - responses of male observers after 35 years



When demonstrating a specifically female manner of expressing the state (an exposition of pride), the advantage in the accuracy of identification also remains with the participants in the experiment. At the same time, in 79% of the expositions presented by the actors, and in 92% of the expositions presented by the actresses, gender stylistics does not appear. The ways of multimodal dynamic expression of the emotional state by men and women are more similar than different.

Estimates of multimodal dynamic expressions depend not only on gender, but also on the age of the observer. When exposed to male faces, male observers under 35 are significantly worse than women in recognizing emotions of surprise ( $m = 0.35$ ;  $w = 0.54$ ;  $U = 279.5$ ,  $p < 0.05$ ), and after 35 - entertainment ( $m = 0.31$ ;  $w = 0.58$ ;  $U = 92$ ,  $p < 0.05$ ), irritations ( $m = 0.43$ ;  $w = 0.74$ ;  $U = 69.5$ ,  $p < 0.05$ ) and anger ( $m = 0.60$ ;  $w = 0.79$ ;  $U = 96.5$ ,  $p < 0.05$ ). When exposed to female faces, there are no statistically significant differences in the responses of both gender groups under 35 years of age, and after 35 years of age, men recognize emotions of joy less accurately ( $m = 0.55$ ;  $w = 0.77$ ;  $U = 98$ ,  $p < 0.05$ ), surprise ( $m = 0.63$ ;  $w = 0.84$ ;  $U = 101.5$ ,  $p < 0.05$ ), irritation ( $m = 0.59$ ;  $w = 0.81$ ;  $U = 96$ ,  $p < 0.05$ ) and anger ( $m = 0.41$ ;  $w = 0.68$ ;  $U = 102.5$ ,  $p < 0.05$ ). Compared with male observers under 35 years old, men over 35 years old are significantly worse at identifying only the emotions of entertainment ( $U = 164$ ,  $p < 0.05$ ) and anger ( $U = 169.5$ ,  $p < 0.05$ ) expressed by women (Fig.4). Age-related decrease in the accuracy of perception of female observers is not registered. The presented results may indicate that the lag in the accuracy of male assessments begins earlier than 35 years and is selective. There is a gender asymmetry in the perception of multimodal emotional states along the line of ontogenesis.

Similar results were partially manifested when using the GERT technique on a Swiss sample in subjects from 17 to 74 years old ( $M = 37.1$ ;  $SD = 13.9$ ) (Schlegel, Scherer, 2016). Correlation analysis confirmed the relationship between a decrease in the overall accuracy of recognition of multimodal dynamic expressions with an increase in the age of observers ( $r = -0.46$ ,  $p < 0.01$ ) and a slight advantage of women in adequate assessments ( $r = 0.13$ ,  $p < 0.05$ ). Women compared with men had higher accuracy in identifying grief ( $r = 0.2$ ,  $p < 0.01$ ), pride ( $r = 0.13$ ,  $p < 0.05$ ) and fear ( $r = 0.16$ ,  $p < 0.01$ ).

A decrease in the overall indicator of recognition accuracy with increasing age was found with the exposure of three emotions of the group of positive states (entertainment, joy, pride), surprise, and all negative emotions except for grief and sadness (group C). In the Russian sample, the advantage of women in recognition accuracy is slightly higher ( $r = 0.24$ ,  $p < 0.01$ ). They are slightly better at recognizing the emotions of entertainment ( $r = 0.21$ ,  $p < 0.05$ ), surprise ( $r = 0.29$ ,  $p < 0.01$ ) and irritation ( $r = 0.2$ ,  $p < 0.05$ ). With increasing age, in contrast to the Swiss sample, only the emotion of entertainment is identified worse ( $r = -0.25$ ,  $p < 0.05$ ).

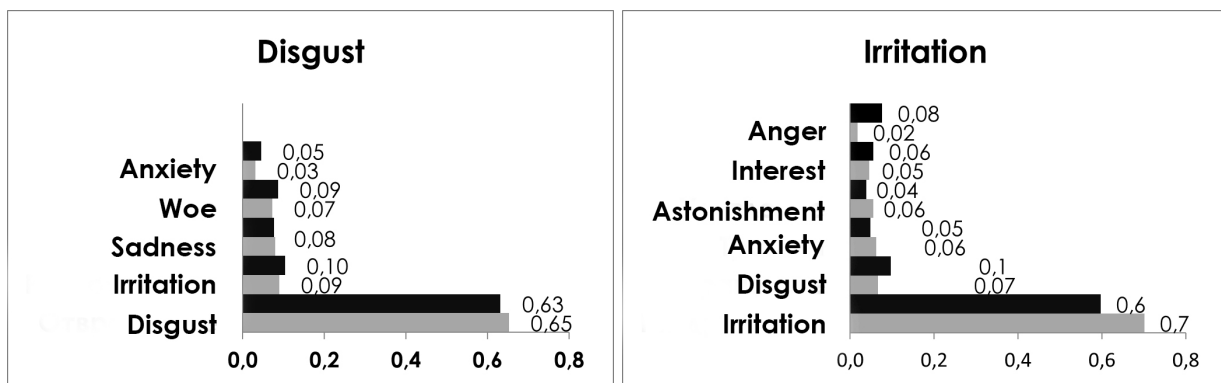
As expected, in the Russian sample, age differences in perception were weak; likely due to the lack of participants over 62 years of age. In contrast to the Swiss sample, for which significant differences in the drop in the accuracy of estimates were obtained for 9 emotions out of 14 (64%), in the Russian sample only 7% of tested emotions are recognized worse with increasing age. The latter is consistent with the results of a study performed using a short version of GERT on subjects under 65 years of age: no decrease in identification accuracy with an increase in the age of observers was registered at all (Schlegel, Scherer, 2016).

Gender and age differences in the assessments of the dynamic states of both men and women in affective groups B, C, D appear only in female observers. Up to 35 years of age, when exposing male sitters, there is a direct dependence of the accuracy of assessments on the intensity of

excitation: anxiety → fear, while exposing a female face - an inverse relationship: anger → irritation. After 35 years, an inverse dependence of identification accuracy was registered: grief → sadness. Differences in the assessments of paired expressions by men were not found. Another argument of the selective influence of sex and age on the perception of the functional state of a "living" person has been obtained. In this context, the gender factor is able to control the perceived relationship between modalities within affective groups with negative valence.

Emotional expressions of the face, as a rule, belong to several categories by observers; a categorical field is formed, including the core - the main most pronounced emotion and the periphery - additional emotions. The generalized structures of the categorical fields of multimodal dynamic expressions of disgust and irritation of observers of different sexes are shown in Figure 5. Histograms show the composition of categories and the values of the frequency of their perception. Values are indicated that exceed the level of random guessing - 0.05. On each of the histograms there is a core corresponding to the displayed emotion, and a periphery - one or more additions.

Comparison of the structure of categorical fields of various emotions shows that for the vast majority of expressions, high values of relative identification accuracy were obtained. The average level of correct answers of observers of both sexes exceeds the level of incorrect ones by 6 or more times. This contrasts with the high individual and gender variability in the way actors position their emotional states. Figure 2 shows a frame-by-frame scan of a multimodal expression of disgust, played differently by an actress and an actor. Despite the obvious differences in the content of each frame and in the sequence of their deployment, the accuracy of disgust identification is equally effective. The plurality of equivalent ways (methods, styles) of the realization of the same affective state is demonstrated, as well as the uncertainty of its static images in relation to multimodal dynamics as a whole.



**Figure 5** . The structure of categorical fields of multimodal dynamic expressions of disgust and irritation. Above are the categories of exhibited emotions, on the side are the responses of observers.

■- women; ■- men

An analysis of the categorical fields of emotional states shows that differences in the recognition of the emotions of a "live" face by representatives of different sexes are manifested not

only in the accuracy of observers' assessments. The composition and structure of perception of additional components of expressions and their variability change. The largest total number of additional emotions was recorded in men's assessments of the affective states of male actors. The greatest difference in the number of additional emotions for male and female observers was noted in group A when evaluating a female face, as well as in the group of ambivalent emotions expressed by actors of both sexes. Men's assessments of ambivalent emotions are distinguished from women's by the presence of additional emotions of negative valence. The most variable additional components in male assessments of a male face are the dynamic states of irritation, disgust, fear, and pride; female face - pride and interest. According to experimental data, male perception, in contrast to female, has a somewhat greater expressive saturation, behind which there is a lowering of sensitivity thresholds to nuances or semitones of expressed emotion. In functional terms, such an ability can contribute not so much to the accuracy of assessments as to the speed of transition from one emotion to another, possibly accelerating the process of recognition.

The performed studies allow us to draw the following **conclusions** .

1. Gender differences in assessments of multimodal dynamic expressions are narrowly selective and depend on a combination of perceptual conditions. Women are more accurate than men in identifying emotional states and most effectively recognize emotions expressed by other women. The male manner of expressing emotions in a number of modalities is more attractive, but is more adequately read by women. Men's perception, in contrast to women's, has a greater affective saturation, sensitivity to the nuances and semitones of the expressed emotion. The described trends do not reach statistical significance in favor of one of the genders.
2. Statistically significant gender and age differences were registered during the perception of five emotions out of fourteen: joy, entertainment, irritation, anger and surprise, and the manifestations of these differences depend on a combination of controlled conditions. On female faces, female observers after 35 years of age are significantly better at recognizing joy, surprise, irritation, and anger. On male faces, men under 35 are worse at recognizing surprise, after 35 - entertainment, irritation, anger.
3. The dependence of the accuracy of recognition of dynamic emotions on the degree of their excitation in male observers was not found, in women it has a multidirectional character, determined by the modality of emotion, the sex of the actor and the age of the observer. In observers under 35 years of age, a significant decrease in the accuracy of recognition of emotions in group D (irritation-anger) was obtained on female faces with an increase in arousal; in observers over 35 years old, the same pattern is reproduced when emotions of group C (sadness-grief) are exposed. On the male faces of group B (anxiety-fear), an increase in arousal causes an increase in the accuracy of identification.
4. Gender differences cover not only the accuracy of recognition of a "live" face, but also the structure of the categorical fields of emotional states in general. The most variable additional components of male assessments of the male face are the multimodal states of irritation, disgust, fear and pride, the female face - pride and interest. Unlike women's, men's assessments of ambivalent emotions are characterized by the presence of additional emotions of negative valence.
5. The patterns revealed in the study make it possible to consider the gender factor in the

- perception of multimodal dynamic expressions of the state of people as a system of determinants that changes its characteristics depending on a particular communicative situation.
6. The results obtained correspond to the most general trends in the manifestation of gender differences in studies of the perception of static images of emotional expressions, as well as people's behavior in real life situations.
  7. The presented work clarifies the methodological and diagnostic capabilities of the Russian-language version of GERT, in particular, marks the areas of data correction depending on gender differences.

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Received: September 16, 2021

Revision received: February 15, 2022

Accepted: February 17, 2022

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**Vladimir Alexandrovich Barabanshchikov** – generation of the idea of the study, formulation of the research problem, analysis of the results of the study, writing the text of the article.

**Ekaterina Vladimirovna Suvorova** - preparation of the technical part of the study, collection of experimental data, work on systematization and processing of data and literary material, writing the text of the article.

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Barabanshchikov, Suvorova  
Gender factor in recognizing the emotional state of a person by his audio-video images  
**RUSSIAN PSYCHOLOGICAL JOURNAL**, Vol. 19, No. 2, 6-20. doi: 10.21702/rpj.2022.2.1

GENERAL PSYCHOLOGY

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#### **Information about the conflict of interest**

The authors declare no conflict of interest.