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Individual Differences Are More Important Than The Emotional Category For The Perception Of Emotional Expressions

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Abstract

Emotional facial expression are an important communication channel between artificial characters and their users. Humans are trained to perceive emotions. Robots and virtual agents can use them to make their inner states transparent. Literature reported that some emotional types, such as anger, are perceived as being more intense than others. Other studies indicated that gender influences the perception. Our study shows that once the individual differences amongst participants are included in the statistical analysis, then the emotion type has no further explanatory power. Artificial characters therefore should adapt to their specific users.

Keywords: emotion, expression, gender, individual differences

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Introduction

In recent years we have observed a dramatic increase in interactive technology that utilizes emotional facial expressions to communicate with the users. This includes highly human like androids, such as the Geminoid series, but also more comic-like characters, such as iCat (Bartneck, Reichenbach, & Breemen, 2004). Facial expressions are already part of our daily messaging culture in the form of Emojis. The assumption is that humans are already trained to recognize human facial expressions and hence artificial characters could utilize these to communicate their inner state or to form a social bond with the users.

Although facial expression recognition has been a subject of thorough study for many years, some issues still remain unresolved. For example, the universality of basic expressions is still under discussion (Russel, 1994). The factors influencing the perceived intensity of a particular emotion are also subject of many recent studies. For example, (Sonnemans & Frijda, 1994) have found that the relation between the five specific intensity factors, namely (1) duration of the emotion and delay of its onset and peak; (2) the magnitude of perceived bodily changes; (3) frequency of recollection and re-experience of the emotion; (4) strength and severity of action tendency, and drasticness of actual behaviour; (5) magnitude of belief changes and influence on long-term behaviour, and the overall felt intensity differed among emotions.

Sonnemans & Frijda, 1995 further reported that, for example, the negative emotions are felt more intensely, while (Hess, Blairy, & Kleck, 1997; Calvo & Nummenmaa, 2016; Wilhelm, Hildebrandt, Manske, Schacht, & Sommer, 2014) found that the overall recognition accuracy was highest for happy expressions and lowest for sad expressions, implying that some emotions need to be expressed more intensely to be recognized as such. Biele & Grabowska, 2006 have also found that the angry faces were generally judged to be more intense than the happy ones. Recognition of fear appears to be particularly problematic, as reported by (Rapcsak et al., 2000), for both, the

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healthy subjects and for patients with focal brain damage. Bartneck et al. (2004) confirmed the difficulty of expressing fear and also described the relationship between the geometrical expression of emotions and their perception (Bartneck & Reichenbach, 2005). Kamachi et al., 2013 reported that suprised faces were better recognized than happy, sad or angry faces.

In addition to the differences in average intensity associated with each of the six basic facial emotional expressions (Anger, Disgust, Fear, Happiness, Sadness, Surprise), many studies have reported differences in facial expression processing and recognition for men and women as well as between people of different ages (McClure, 2000; Calder et al., 2003). Biele & Grabowska, 2006 report that the differences between girls and boys were apparent very early on. Although women in general tend to demonstrate greater accuracy when interpreting non-verbal clues, women were found to be better at recognizing facial expressions of fear and sadness, while men were reported to be superior at identifying expressions of anger. Similarly, while age in general seemed to correlated with less accurate perception of emotional expressions, recognition of sadness and disgust appeared to be better in older people. Calder et al., 2003 state that the above differences are small, but consistent.

There is also evidence for cultural differences in emotion recognition (Matsumoto & Ekman, 1989). Moreover the identification of emotions displayed by robots or avatars may depend on the cultural perception of robots' helpfulness and friendliness in general (Becker-Asano & Ishiguro, 2011; Koda, 2007). Dynamic perception, i.e., facial emotion recognition from animation, appeared to be better than static perception (Biele & Grabowska, 2006). In addition to the above trends, there is also continuously accumulating evidence for individual differences as reported by, among others, (Sonnemans & Frijda, 1995) and (Suzuki, Hoshino, & Shigemasu, 2006).

A better understanding of emotion perception, facial expression processing and recognition is important not only for the study of human psychology. It is also increasingly vital in the field of the human-computer and human-robot interaction, where the facial expression recognition has to occur in real time. Whereas traditionally

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robots were created for physically demanding and dangerous tasks, and were meant to operate far away from humans, now they have a range of applications in, for example, health care and entertainment, which brings them into increasing contact with people (Breazeal, 2003). It is thus important to understand how to make the robots to mimic and to elicit various emotions, and therefore to determine the factors which affect their perception (see, for example, (Broadbent, Stafford, & MacDonald, 2009). Hwang, Park, & Hwang, 2013 have found that even the shape of a humanoid robot has an effect on the human perception of the robot's personality. Breazeal, 2003 has looked at the emotions elicited either by static images or by video recording of the Kismet robot. The dynamic assessment was found to be somewhat more accurate than the static one: 57%-86% correct vs. 47%-83% emotion-specific identification respectively. In a similar experimental framework, McColl & Nejat, 2014 looked at the accuracy of perception of emotion expressed by a human like robot and by a human actor. They also report interpersonal variability in emotional perception as well as the difference between the two agents.

Perhaps the best way to summarize all of the above is to use the words of Suzuki et al., 2006: *"one of the most widespread characteristics of emotional experience is the striking nature of the variability among individuals"*. In this study, we turn to the emotional assessment of the faces of LEGO Minifigures. In their survey of socially interactive robots, Fong, Nourbakhsh, & Dautenhahn, 2003 classify the robots into four broad categories: anthropomorphic, zoomorphic, caricatured, and functional. The cartoon-type faces of the LEGO Minifigures are the good example of the caricature. There are several hundred different LEGO faces offering an extremely wide spectrum of emotional expressions. Understanding the emotional perception of these LEGO Minifigure faces can thus contribute to the understanding of the emotional perception of robots and avatars from the caricatured category. In this study, we have used a sample of LEGO Minifigure faces to addresses the following research questions:

1. Are some emotional categories perceived as more intense than others?

2. Do men perceive emotions differently than women?

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3. To what extent do individual variations influence the facial expression processing?

In the process of answering these questions we do not only contribute to the existing body of knowledge on variability of emotions perception, but also highlight the importance of correct application of statistical methodology, namely accounting for person- and figurine-specific random effects.

Method

We conducted an experiment in which participants had to rate the perceived emotional expression of LEGO Minifigures. We then analyzed the responses received to answer the research questions. The advantage of using LEGO Minifigures is that they offer an extreme wide spectrum of emotional expression. There are several hundred different LEGO faces. By sampling from this population we ensure not to introduce any specific bias into the stimuli.

Participants

Sixty participants, comprising of 22 men and 38 women of an average age of 38.3 years (SD=12.5 yrs) were recruited for the study. The participants were recruited on the campus of the University of Canterbury.

Process

The participants were welcomed to the study and were seated in front of a computer. After reading the instructions and signing the consent form the participants could ask question to the experimenter. If the participants had no more questions the experiment started. After providing demographic information, the participants were tasked to rate the exact same set of 94 LEGO Minifigures using the computer in front of them (see figure 1). After completing the task the participant were debriefed and had again the opportinity to ask any questions they might have. The experiment took approximately 30 minutes to complete.

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Stimuli

While many facial expression recognition studies use a photographs of human facial expressions, in this study we have used a set of 94 LEGO Minifigures. These facial expressions are designed to cover a large variety of expressions and intensity levels. Figure 2 shows some examples of Minifigures used in the study. The Minifigures were randomly selected from a larger set of 722 Minifigures used in a previous study (Bartneck, Obaid, & Zawieska, 2013). The previous study focused on the historical development of the LEGO Minifigures and found that their expressions have become far more diverse and that in particular angry faces have become more frequent. This study turns the table and we are now investigating how the characteristics of the emotions and the participants influenced the perception of the LEGO Minifigures.

Measurements

Each Minifigure had to be rated by the participants to represent one of six emotions (Anger, Disgust, Fear, Sadness, Happiness, Surprise) with one out of five intensities (weak (1) to intense (5)). The questionnaire only allowed for one combination of emotional category and intensity. If, for example, the participant first considers a face to express fear at intensity level 4 and then changes his/her mind to surprise at intensity level 3, then only the later would be recorded. Thus, a total of 60*94=5640 responses with only 2 missing values were recorded.

Results

The frequency distribution of the responses is shown in Table 1. Most of the figurines were classified as either happy (49%) or angry (21%), and rated to be 2 or 3 on the intensity scale (27% and 24% respectively). The observed average intensity was highest for Fear (3.35) and lowest for Disgust (2.79). It should be noted, that assignment of emotions to Minifigures was not necessarily unanimous: 44 out of 92 Minifigures were assigned each of the six emotions at least once, and further 31 were assigned all but one emotion at least once. In fact, there was a lot of disagreement

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between raters with respect to both the emotion and the intensity of the emotion perceived. Most of the Minifigures (81 out of 94) had all possible emotional intensity ratings assigned at least once. However, the 'dominant' emotional intensity, i.e., the rating assigned most often, had on average 25 participants agreeing with it. The Fleiss' Kappa statistic for emotions was evaluated at 0.369 and for intensities at 0.124, indicating weak agreement. This indicates, that it is important to account for inter-rater as well as inter-minifigure variability when performing statistical analysis.

Statistical Methods

In order to investigate association between intensity and type of emotion, a mixed-effects cumulative proportional odds ordinal logistic model was fitted. (Agresti, 2010). Let Y_{ij} be the intensity assigned by rater i to minifigure j. Then the cumulative probability distribution of the intensity conditional on emotion can then be modeled as:

$$h(Pr(Y_{ij} \leq y | X_{ij} = k)) = \alpha_y + \omega_k + \beta_s sex + \beta_a age + \xi_i + \phi_j, \quad (1)$$

where k is the emotion assigned by rater i to minifigure j, β_s and β_a account for the effects of sex and age respectively, ξ_i and ϕ_j are rater- and minifigure-specific random effects, accounting for repeated measures, ω_k is the effect, capturing association between emotion and intensity, and α_y is the intensity category-specific intercept. The link function h was chosen to be logit as is customary. For the purposes of model identifiability, $\omega_1 = 0$ and *Anger* is considered the reference emotion.

Since preliminary data analysis indicated the presence of substantial rater- and minifigure-specific variation, quantification of the sources of variance was of interest. (Martina Mittlböck & Shemper, 1996) and (Menard, 2000) discuss some ways to measure the proportion of variation attributable to various factors in binary and multinomial logistic regressions without specifically discussing the case of ordinal response. We have chosen to use the likelihood ratio based R^2_L defined as follows:

$$R^2_L = \frac{-2(\ln(L_0) - \ln(L_M))}{-2\ln(L_0)} = \frac{\ln(L_0) - \ln(L_M)}{\ln(L_0)} \quad (2)$$

due to the fact that it naturally varies between 0 and 1 and has a proportional reduction error interpretation (Menard, 2000).

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In order to analyse statistical significance of a particular factor, a model with and without the factor can be compared using the likelihood ratio test, in which case the χ^2 statistic and the associated p-value can be reported.

All the analyses were implemented using R-software.(R Core Team, 2014) The *ordinal* package was used for fitting the model 1 (Christensen, 2015).

The results of the estimation of the full model, adjusted for sex and age-group and including rater- and minifigure-specific random effects 1 are shown in Table 2 and Figure 3. Women were found to perceive emotions as more intense than men (p=0.0314) and raters aged 30-49 were found to perceive emotions as more intense than raters aged 15-29. Although there were slight differences in the perceived intensity of different emotions, these differences were not found to be statistically significant ($\chi^2_5 = 1.2623$,$p = 0.9388$). It should be noted that in a fixed effects model, which does not take into account repeated assessment set-up, the differences in the perceived emotional intensity come out as highly statistically significant ($\chi^2_5 = 84.783$, $p < .0001$). Besides the obvious lesson of the importance of correctly adjusting for random effects, this results brings out the importance of the inter-rater and inter-figurine variation, which was then investigated using the R^2_L coefficient, the results for which are shown in Table 3. The ratio R^2_L indicates proportional improvement, i.e., increase in likelihood due to consecutive addition of various factors to the null model $h(Pr(Y_{ij} \leq y|X_{ij} = k)) = \alpha_y$. The largest proportional increase is due to the accounting for inter-rater and inter-minifigure variability. While accounting for the type of emotion after adjusting for age and sex leads to approximately 1% improvement in the likelihood, adding random effects leads to additional $(e^{0.1996} - 1) * 100\% = 22\%$ improvement in likelihood.

Discussion

Sixty men and women of different age were asked to assign a particular emotion and the associated intensity to each of the 94 LEGO Minifigures. The results confirm earlier findings that women tend to perceive emotional expressions generally more

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intensely, and that older people (aged over 30 y.o.) tend to perceive emotions as less intense than the younger people (under 30 y.o.). However, once the model accounted for the Minifigure- and rater-specific effects, no difference was found in the emotion-specific intensity distribution. The rater-specific variation was found to constitute a substantial part of the variance observed in the response.

This striking variability has already been reported earlier by, for example, (Sonnemans & Frijda, 1995) and (Suzuki et al., 2006). Our study confirms the necessity of always taking it into account when analysing or otherwise modeling facial expression perception. In our case, failure to adjust for the random effects would have resulted in incorrect conclusion of statistically significant effect of emotion on intensity perception.

Although we have mentioned the previously reported importance of culture on perception of emotions (Matsumoto & Ekman, 1989; Becker-Asano & Ishiguro, 2011; Koda, 2007), we were unable to account for the cultural background in this study. Extending the number of participants and controlling for ethnical and cultural background may provide further insights into the extent of interpersonal variation in emotional perception.

In some studies, such as (Breazeal, 2003) and (McColl & Nejat, 2014), it is possible to speak of accuracy of emotional perception in the sense of the user correctly perceiving the emotion that the agent, whether the human actor or the robot, was meant to express. However, we need to point out that there is no ground truth in the expression and perception of emotions. In fact, as our results show, the emotion appears to be really in the eye of the beholder. We used the established approach of inviting a large sample of participants to rate stimuli using a Likert scale. It should also be noted that the stimuli used in our experiment were static photographs of a certain style of faces. We were somewhat surprised to find the weak agreement between the respondents as to the emotion and the associated intensity represented by each LEGO Minifigure despite the fact that the facial expressions of Minifigures are fairly simple and highly stylized. The results for animated facial expression or for static, but more realistic human faces (e.g. photographs) could be different. It would be enlightening to see

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whether the variability in user-specific perception is likely to be a general phenomenon independent of the agent (human actor, humanoid robot, stylized avatar etc.) and the manner of presentation (static recording, dynamic recording, real time interaction). While there are some indications that it is so (see, for example (Breazeal, 2003) and (McColl & Nejat, 2014)), more studies are needed to provide a definitive conclusion.

Robots and computers are becoming more and more part of our lives. Their roles differ widely but are expected to include teaching and caring (Broadbent et al., 2009). Even though robots might not be specifically designed to express emotions, the users are likely to perceive them anyway. Facial emotional expression can play an important role in communicating the robots emotional states. Hence it does pay to consider the emotional messages robots send, and that is what many researchers are doing (see, for example, (Bonarini, 2016)). However, given the users' high individual variability of the perception of emotions, which this study serves to confirm, it does seem necessary for the artificial character to adapt to each specific user instead of attempting generic expressions.

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References

Agresti, A. (2010). *Analysis of ordinal categorical data.* Wiley.

Bartneck, C., Obaid, M., & Zawieska, K. (2013). Agents with faces - what can we learn from lego minfigures. In *1st international conference on human-agent interaction* (p. III-2-1). Retrieved from http://hai-conference.net/ihai2013/proceedings/pdf/III-2-1.pdf

Bartneck, C., & Reichenbach, J. (2005). Subtle emotional expressions of synthetic characters. *The international Journal of Human-Computer Studies*, *62*(2), 179-192. doi: 10.1016/j.ijhcs.2004.11.006

Bartneck, C., Reichenbach, J., & Breemen, A. (2004). In your face, robot! the influence of a character's embodiment on how users perceive its emotional expressions. In *Proceedings of the design and emotion 2004 conference.* Retrieved from http://www.bartneck.de/publications/2004/inYourFaceRobot/bartneckDE2004.pdf

Becker-Asano, C., & Ishiguro, H. (2011, April). Evaluating facial displays of emotion for the android robot geminoid f. In *Affective computational intelligence (waci), 2011 ieee workshop on* (p. 1-8). doi: 10.1109/WACI.2011.5953147

Biele, C., & Grabowska, A. (2006). Sex differences in perception of emotion intensity in dymanic and static facial expressions. *Exp Brain Res*, *171*, 1-6.

Bonarini, A. (2016). Can my robotic home cleaner be happy? issues about emotional expression in non-bio-inspired robots. *Adaptive Behavior*. Retrieved from http://adb.sagepub.com/content/early/2016/10/09/1059712316664187.abstract doi: 10.1177/1059712316664187

Breazeal, C. (2003). Emotion and sociable humanoid robots. *International Journal of Human-Computer Studies*, *59*(1–2), 119 - 155. Retrieved from http://www.sciencedirect.com/science/article/pii/S1071581903000181 (Applications of Affective Computing in Human-Computer Interaction) doi: http://dx.doi.org/10.1016/S1071-5819(03)00018-1

Broadbent, E., Stafford, R., & MacDonald, B. (2009). Acceptance of healthcare robots

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for the older population: Review and future directions. *International Journal of Social Robotics*, *1*(4), 319. Retrieved from http://dx.doi.org/10.1007/s12369-009-0030-6 doi: 10.1007/s12369-009-0030-6

Calder, A. J., Keane, J., Manly, T., Sprengelmeyer, R., Scott, S., Nimmo-Smith, I., & Young, A. (2003). Facial expression recognition across the adult life span. *Neuropsychologia*, *41*, 195-202.

Calvo, M. G., & Nummenmaa, L. (2016). Perceptual and affective mechanisms in facial expression recognition: An integrative review. *Cognition and Emotion*, *30*(6), 1081-1106. Retrieved from http://dx.doi.org/10.1080/02699931.2015.1049124 doi: 10.1080/02699931.2015.1049124

Christensen, R. H. B. (2015). *ordinal—regression models for ordinal data.* (R package version 2015.6-28. http://www.cran.r-project.org/package=ordinal/)

Fong, T., Nourbakhsh, I., & Dautenhahn, K. (2003). A survey of socially interactive robots. *Robotics and Autonomous Systems*, *42*(3–4), 143 - 166. Retrieved from http://www.sciencedirect.com/science/article/pii/S092188900200372X (Socially Interactive Robots) doi: http://dx.doi.org/10.1016/S0921-8890(02)00372-X

Hess, U., Blairy, S., & Kleck, R. E. (1997). The intensity of emotional facial expressions and decoding accuracy. *Journal of Nonverbal Behavior*, *21*(4), 241–257. Retrieved from http://dx.doi.org/10.1023/A:1024952730333 doi: 10.1023/A:1024952730333

Hwang, J., Park, T., & Hwang, W. (2013). The effects of overall robot shape on the emotions invoked in users and the perceived personalities of robot. *Applied Ergonomics*, *44*(3), 459 - 471. Retrieved from http://www.sciencedirect.com/science/article/pii/S0003687012001688 doi: http://dx.doi.org/10.1016/j.apergo.2012.10.010

Kamachi, M., Bruce, V., Mukaida, S., Gyoba, J., Yoshikawa, S., & Akamatsu, S.

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(2013). Dynamic properties influence the perception of facial expressions. *Perception*, *42*(11), 1266-1278. Retrieved from `http://pec.sagepub.com/content/42/11/1266.abstract` doi: 10.1068/p3131n

Koda, T. (2007). Cross-cultural study of avatars' facial expressions and design considerations within asian countries. In *Intercultural collaboration* (pp. 207–220). Springer.

Martina Mittlböck, M., & Shemper, M. (1996). Explained variation for logistic regression. *Statistics in Medicine*, 1987-1997.

Matsumoto, D., & Ekman, P. (1989). American-japanese cultural differences in intensity ratings of facial expressions of emotion. *Motivation and Emotion*, *13*, 143-157.

McClure, E. B. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. *Psychological Bulletin*, *126*(3), 424-253.

McColl, D., & Nejat, G. (2014). Recognizing emotional body language displayed by a human-like social robot. *International Journal of Social Robotics*, *6*(2), 261–280. Retrieved from `http://dx.doi.org/10.1007/s12369-013-0226-7` doi: 10.1007/s12369-013-0226-7

Menard, S. (2000). Coefficients of determination for multiple logistic regression analysis. *The American Statistician*, 17-24.

R Core Team. (2014). R: A language and environment for statistical computing [Computer software manual]. Vienna, Austria. Retrieved from `http://www.R-project.org/`

Rapcsak, S., Galper, S., Comer, J., Reminger, S., Nielsen, L., & Kaszniak, A. (2000). Fear recognition deficits after focal brain damage—a cautionary note. *Neurology*, *54*, 575–581.

Russel, J. A. (1994). Is there universal recognition of emotion from facial expression? a review of the cross-cultural studies. *Psychological Bulletin*, *115*, 102-141.

Sonnemans, J., & Frijda, N. (1994). The structure of subjective emotional intensity.

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Cognition and Emotion, *8*, 329-350.

Sonnemans, J., & Frijda, N. H. (1995). The determinants of subjective emotional intensity. *Cognition and Emotion*, *9*, 483-506.

Suzuki, A., Hoshino, T., & Shigemasu, K. (2006). Measuring individual differences in sensitivities to basic emotions in faces. *Cognition 99*, 327-353.

Wilhelm, O., Hildebrandt, A., Manske, K., Schacht, A., & Sommer, W. (2014). Test battery for measuring the perception and recognition of facial expressions of emotion. *Frontiers in Psychology*, *5*, 404. Retrieved from `http://journal.frontiersin.org/article/10.3389/fpsyg.2014.00404` doi: 10.3389/fpsyg.2014.00404

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	Intensity					Total	(%)	Intensity
Emotion:	1	2	3	4	5			
Anger	181	271	264	251	245	1212	21%	3.08 (1.35)
Disgust	88	191	173	124	56	632	11%	2.79 (1.17)
Fear	33	66	67	67	89	322	6%	3.35 (1.35)
Happiness	463	771	664	504	340	2742	49%	2.81 (1.27)
Sadness	56	77	67	63	30	293	5%	2.77 (1.27)
Surprise	56	123	63	82	62	437	8%	2.93 (1.24)
Total	877	1499	1349	1091	822	5838		
(%)	15%	27%	24%	19%	15%	100%		

Table 1

Observed distribution of emotion and intensity ratings of 92 *LEGO Minifigures by* 60 *raters*

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		Estimate	Std. Error	z value	p-value
Thresholds:					
	α_1	-2.2106	0.5375	-4.113	
	α_2	-0.1215	0.5367	-0.226	
	α_3	1.4903	0.5370	2.775	
	α_4	3.2632	0.5386	6.059	
Other coefficients:					
Digust vs. Anger	ω_2	0.0682	0.1029	0.662	0.5078
Fear vs. Anger	ω_3	0.0333	0.1460	0.228	0.8198
Happiness vs. Anger	ω_4	-0.0240	0.1001	-0.240	0.8101
Sadness vs. Anger	ω_5	0.0970	0.1398	0.694	0.4879
Surprise vs. Anger	ω_6	0.0376	0.1368	0.275	0.7833
Women vs. Men	β_s	0.6442	0.2993	2.152	0.0314
aged 30-49 vs. 15-29	β_1	-0.7447	0.3358	-2.218	0.0266
aged 50+ vs. 15-29	β_2	-0.6796	0.4460	-1.524	0.1275

Table 2

The results of estimating model 1.

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Model	R_L^2
$h(Pr(Y_{ij} \leq y \mid X_{ij} = k)) = \alpha_y + \beta_s sex + \beta_a age$	0.0066
$h(Pr(Y_{ij} \leq y \mid X_{ij} = k)) = \alpha_y + \omega_k + \beta_s sex + \beta_a age$	0.0114
$h(Pr(Y_{ij} \leq y \mid X_{ij} = k)) = \alpha_y + \omega_k + \beta_s sex + \beta_a age + \xi_i$	0.1399
$h(Pr(Y_{ij} \leq y \mid X_{ij} = k)) = \alpha_y + \omega_k + \beta_s sex + \beta_a age + \xi_i + \phi_j$	0.1996

Table 3

Variance explained by various models as compared to the null model $h(Pr(Y_{ij} \leq y|X_{ij} = k)) = \alpha_y$ *as expressed via the likelihood ratio* R_L^2*. The ratio indicates proportional improvement, i.e., increase in likelihood due to addition of various factors. The largest proportional increase is due to the accounting for inter-rater and inter-minifigure variability.*

Moltchanova, E., & Bartneck, C. (2017). Individual Differences Are More Important Than The Emotional Category For The Perception Of Emotional Expressions. Interaction Studies, 18(2), 161-173. | DOI: 10.1075/is.18.2.01mol

Figure 1. Screenshot of the computer based questionnaire.

Moltchanova, E., & Bartneck, C. (2017). Individual Differences Are More Important Than The Emotional Category For The Perception Of Emotional Expressions. Interaction Studies, 18(2), 161-173. | DOI: 10.1075/is.18.2.01mol

(a) A standard Minifigure (b) A movie actor

Figure 2. Example Minifigures

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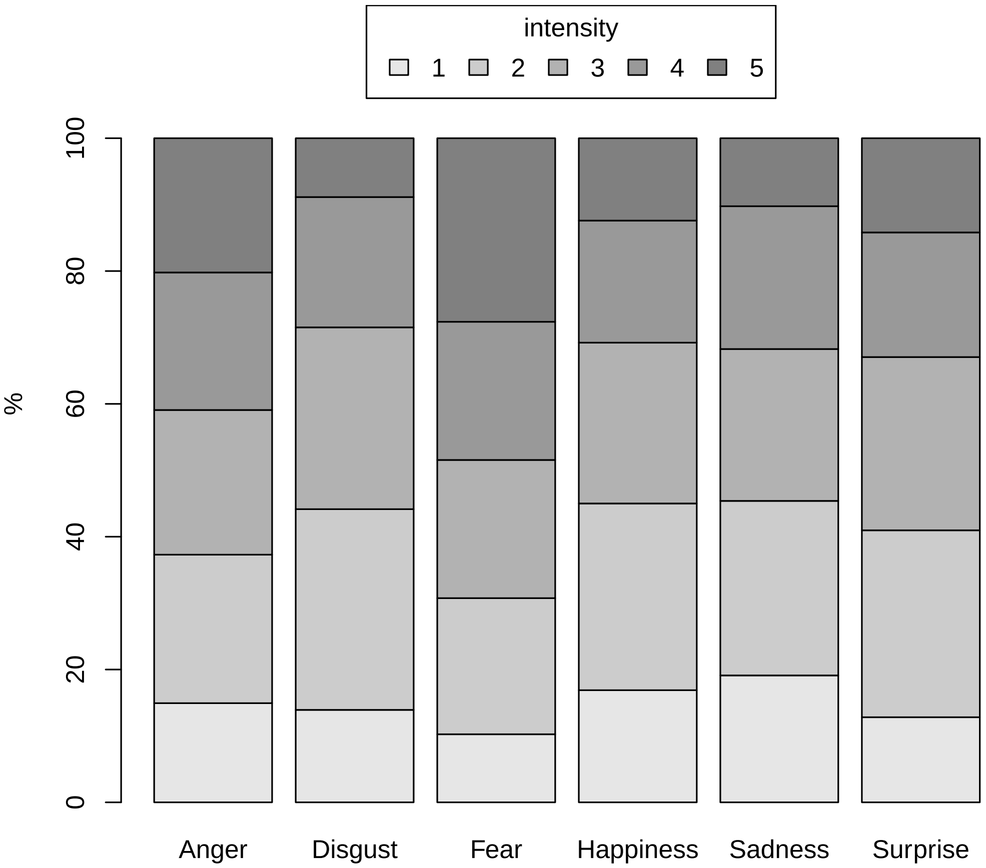

Figure 3. Observed proportions of emotional intensity, on a scale from 1 to 5, by the attributed emotion.