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Feelings and contexts: socioecological influences on the nonverbal expression of emotion

Paula M Niedenthal[1], Magdalena Rychlowska[2] and Adrienne Wood[1]

Despite their relative universality, nonverbal displays of emotion are often sources of cross-cultural misunderstandings. The present article considers the relevance of historical and present socio-ecological contexts, such as heterogeneity of long-history migration, pathogen prevalence, and residential mobility for cross-cultural variation in emotional expression. We review recent evidence linking these constructs to psychological processes and discuss how the findings are relevant to the nonverbal communication of emotion. We hold that socioecological variables, because of their specificity and tractability, provide a promising framework for explaining why different cultures developed varying modes of emotional expression.

Addresses
[1] University of Wisconsin-Madison, USA
[2] Cardiff University, UK

Corresponding author: Niedenthal, Paula M (niedenthal@wisc.edu)

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Consider the smile. Despite its considerable universality [1], the intensity and frequencies of smiles vary across cultures [2]. For example, Tsai and colleagues [3] compared the size of smiles displayed by American and Chinese government leaders, chief-executive-officers, and university presidents in official photos. American leaders tended to display more 'excited' or intense smiles than Chinese leaders, who displayed calmer smiles. These findings and findings of follow-up studies are consistent with self-reported display rules and norms for valued emotional states in Asian versus North American cultures. And Szarota [4] demonstrated that smiles are less frequent in the social media use of Eastern versus Western Europeans. Similarity and difference in the intensity and frequency of other types of expression of emotion can also be seen across culture.

In this article, we consider the dimensions of culture that are perhaps most potent influences on emotional expression. We place particular emphasis on present and historical socio-ecological contexts, and illustrate their relevance using as a case study our own research on heterogeneity of long-history migration and emotion expressivity. The current state of the literature indicates that cross-cultural emotion research will progress by identifying the unique pressures different socio-ecological forces place on people, producing distinct cultures of emotion expression.

The signal and the noise: cultural similarities and differences in emotion expression

While the recognition of some expressions of emotion occurs at rates superior to chance across cultures [5], and there is evidence that facial expressions in particular continue to serve functions for which they may have evolved (see [6] for review, also [7,8]), there are also cross-cultural differences in the recognition of emotion from nonverbal displays [9,10], especially the recognition of posed facial expressions [11,12]. Some of these differences concern emotions with less clearly defined expressions. For example, recognizing love from patterns of bodily movement was found to be below chance in a remote Khmer culture [13]. However, even the expression of discrete, perhaps basic, emotions such as fear may also give rise to misunderstandings. In a recent study, observers from Papua New Guinea interpreted the expression of fear as an anger display [14]. Findings initially supporting recognition of basic emotions from nonverbal vocalizations in a remote African culture [15] stimulated replications showing the opposite [16] and started heated discussion [17,18].

Researchers continue to debate if and how many underlying categories of facial expression exist [19], as well as the best way to test hypotheses of universality [20]. Much of this debate appears to stem from the field's inability to settle on an operational definition for emotion, as well as different researchers' preferences to place great weight on signal versus noise in the production and recognition of facial expression of emotion across culture. Setting this debate aside, we begin with the assumption that some aspects of facial expression serve the same social function across the human species, but that culture and learning influence these innate/universal behaviors to make them maximally functional within each social environment (see Emotion Dialect Theory [21,22]). Cultures contribute not only to the occurrence of emotional expression, but also to

the display rules surrounding when and how intensely emotions are expressed [23–26]. Thus, cross-cultural differences exist in how and when emotional expressions occur, due to emotion dialects, culturally prescribed emotion regulation goals, and the degree to which certain emotions are functional within a social environment. Until recently it has been less clear which features of cultures and social environments give rise to variability in emotional expression.

An overemphasis on collectivism–individualism?

A cultural dimension that has received substantial attention in cross-cultural psychology, and in emotion research as well, is collectivism–individualism (CI [27]). Some researchers hold that in collectivistic societies, which encourage the preservation of stable groups, individuals define themselves in terms of their group membership. With respect to emotions, collectivist values should be related to a reluctance to display socially disruptive emotions in the service of preserving group harmony, and indeed a reluctance to show strong emotion at all because such displays would increase the salience of the individual. In individualistic societies, associated with transient social bonds and permeable group boundaries, in contrast, personal identity is more important than group identity. Consistent with these proposed distinctions, researchers have found that members of collectivistic societies are less emotionally expressive than are members of individualistic societies [24], and perceive emotions in others as related to group-level rather than individual-level experience [28].

While the construct of CI provides insights into sources of cross-cultural variation in emotional expression, it proves not without problems [29,30••]. First, it is unclear whether the measurement of individual-level CI in large national surveys or questionnaires relates to actual societal phenomena [31,32]. On the other hand, subjective judgments of country-level CI offered by individual researchers (e.g. [33]) lack empirical basis and clear scoring criteria. Country-level CI scores have been shown to contradict averaged individual-level scores [34•], and jumping between country-level and individual-level measures of CI (or, relatedly, independence-interdependence) risks committing the ecological fallacy [35]. Furthermore, much cross-cultural work focuses on comparison between Europeans/European-Americans and East Asians, neglecting the rest of the globe and glossing over differences within East Asian and Western nations and cultures. By attending primarily to the East versus West comparison, this work can only say that there are differences, but not why those differences exist [30••,36].

Through the lens of social ecology

Emotional expression would not exist if it did not serve a function, and to the extent that cultural differences exist, people's use of emotion expressions must be in response to pressures in their social worlds. Investigating past and present socioecological contexts may help explain the observed cultural variability in expression. Socioecological variables describe specific, quantifiable phenomena occurring in a specific country or geographical region, making them more tractable than abstract constructs like CI.

The root causes of abstract cultural dimensions such as CI likely involve a degree of chaos and randomness, but at least some variability on these dimensions can be attributed to socioecological factors [37•,38,39]. For example, country-level GDP correlates with levels of CI [40]. Residential mobility, defined as the frequency with which people change their residence, predicts independent versus interdependent self-construals [41]. Kitayama and colleagues [39] showed that a history of settlement in potentially dangerous, wild, and promising frontier regions can favor the development of independent, versus interdependent, selves, which is likely to be associated with different emotion processing styles.

When studying geographic, economic, and societal contexts, one can investigate their present form or examine the historical constructs. While the current environments influence behavior and emotional expression in real time, accounting for historical circumstances can provide insights into initial pressures on emotional expressions that shaped a given society and exerted its influence over the history through norms and institutions [32]. Initial cultural adaptations to specific socioecological pressures can, over centuries, lead to dramatic differences between present emotion cultures, pushing them to different equilibriums [42]. As an example, in Chinese regions with a history of rice growing, requiring elaborate irrigation systems and coordinated efforts, participants showed higher levels of holistic thinking and collectivism than participants from regions with a history of growing wheat, requiring less cooperation [37•]. These cultural differences remained even when the original ecological forces became irrelevant.

The impact of socioecological factors on emotion expression is a largely unexplored topic. One promising factor is pathogen prevalence, a construct indexing the possible risks of contamination through human contact. Pathogen prevalence is correlated with CI [38], and thus indirectly with emotional expressivity [24]. Relatively stable group boundaries, described as one of the key elements of collectivist societies, are a functional adaptation to the distant past, when the contact of members of other groups could represent a danger. Initial evidence suggests that pathogen prevalence predicts the verbal expression of certain avoidance-related emotion expressions: researchers analyzed a large corpus of American English books and movie and television dialogs over the 20th century

and observed that historical levels of pathogen prevalence were positively correlated with the use of words related to contempt and disdain [43•].

Long-history migration and the social functions of smiles

We recently demonstrated the ability of a socioecological variable to explain cross-cultural differences in both emotion expressivity and the social functions of smiles, over and above more common cultural constructs such as CI. This dimension, known as historical heterogeneity, is a historical-demographic construct that describes the number of source countries or regions that contributed to the present population of a given culture. Putterman and Weil [44] provided an index of this construct for 165 countries, by describing, for each country, the number of source countries that contributed to the population of this country over the last 500 years. Historically homogeneous countries, such as Japan or Norway, have only few (or one) source countries, while heterogeneous cultures descend from multiple countries, with United States having as many as 83 source countries. As a construct, historical heterogeneity is therefore conceptually related to residential mobility [41] as both increase pressures on interacting with strangers and are likely associated with flexible group boundaries. However, whereas residential mobility operates in the present, influencing ongoing behaviors, historical heterogeneity represents an initial condition, creating specific communication pressures, encouraging specific functions of emotions, and solidifying these patterns through institutions and societal practices [42].

High historical heterogeneity indicates contexts of extended contact between groups of people not sharing language, norms, or societal structures — in sum, environments creating pressures to reliably communicate one's intentions and to clearly signal one's trustworthiness. An initial study relating historical heterogeneity to emotion processes reanalyzed a set of cross-cultural data from 27 countries [24,25••] and showed that heterogeneity explained unique variance in the individual-level norm of open emotion expressivity, even after controlling for other potentially relevant variables, such as GDP, population density, tightness, or power distance. Two collectivism measures [33,45] and residential mobility also predicted expressivity, but historical heterogeneity explained the most unique variance. The fact that two indexes of present-day demographic heterogeneity — namely, present migration and ethnic fractionalization [46] — did not explain significant portions of variance demonstrates that historical and present ecological variables may shape expressivity norms in different ways. This finding was recently replicated in a much larger study of actual expressive behavior [47••]. In particular, the researchers analyzed spontaneous smiling to advertisements by 866, 726 participants from 31 countries. While smiling was positively associated with individualism and negatively associated with population density, only historical heterogeneity explained significant unique variance in smiling. Indeed, the standardized regression coefficient was .52. Thus, holding all other variables constant, members of heterogeneous societies with twice the heterogeneity of another country smiled 1% more to a given stimulus.

In subsequent studies, we also explained how historical heterogeneity relates to different social functions of smiling in nine countries that spanned the continuum of historical heterogeneity [25••,48]. Smiles, typically described in the literature as a function of their authenticity (or lack of thereof [49]), have recently been subjected to a social-functional analysis [48]. In the social-functional view, different smiles can solve the basic tasks of social living, including rewarding self and other (reward smiles), cueing non-threat (affiliative smiles), and negotiating social hierarchies (dominance smiles). The conditions under which smiling occurred in the nine countries formed three factors, corresponding to the social-functional categories of reward, affiliation, and dominance [48].

A cluster analysis applied to the data further showed that respondents could be grouped into two categories, best predicted by their country's historical heterogeneity [25••]. Members of the 'homogeneous' group, mostly composed of Japanese, Indonesian, French, Indian, and German respondents, tended to endorse conditions indicative of affiliative smiles less and dominance smiles more than members of the 'heterogeneous' group, mostly comprising Americans, New Zealanders, Israeli, and Canadians. Again, the effect persisted after controlling for other relevant variables, confirming the potential of historical heterogeneity in predicting cross-cultural variability in smiling. The fact that homogeneous countries endorse affiliative smiles to a lesser extent than did homogeneous countries may at least partly explain the finding that in certain countries, such as France [50] or Poland [4], excessive smiling is treated with distrust and interpreted as a lack of sincerity or an abundance of stupidity [51,52]. It is possible that in such societies smiles function primarily to communicate joy or manipulation and control. A smile expressed as a signal of trust and affiliation may therefore be misinterpreted as false and dishonest.

We also reanalyzed data from a meta-analysis on in-group bias in emotion recognition accuracy [53], and demonstrated that the historical heterogeneity scores of an expresser predict how well people from other cultures recognize an expression [54••]. This provided initial behavioral evidence that country-level historical heterogeneity creates initial conditions encouraging clear communication of one's feelings.

Conclusions and future directions

While the studies described above suggest the potential of present and historical environments for explaining psychological processes and emotions across cultures, they are just an initial step in the triangulation of the sources of this variability. Techniques such as reverse correlation [55•,56] will provide insight into how respondents from different socioecological niches mentally represent emotion expressions. Avatars and robots allow a precise control of facial and bodily displays and a growing evidence documents their utility for cross-cultural research (e.g. [57]).

Investigating past and present ecological contexts also creates unique opportunities for interdisciplinary research between historians, economists, social scientists, and psychologists. Studies reviewed in this article provide mostly correlational evidence of links between socioecological contexts, cultural variables, and emotion processing. Future research will need to investigate processes through which this influence operates. What exactly makes highly mobile, heterogeneous societies more expressive? How do people from countries with high versus low history of pathogen prevalence process and imitate expressions of emotion displayed by strangers? How would mental representations or facial mimicry of ingroup or outgroup members differ for people from countries with wheat versus rice culture history? The investigation of historical contexts as predictors of emotional expressions may require collaborations between historians and psychologists. First, the very definition of these variables can be problematic, as data on historical ecology or population statistics are often scarce [58]. Hence the necessity of using multiple indexes and regions for these measurements, given the potential within-country variability. While the two studies from our lab described above used the same measure of heterogeneity [44], future studies will also investigate historical heterogeneity within the United States using census data.

Finally, while it is impossible to directly assess the impact of distal variables on the ways people process emotion today, such effects can be at least approximated by experimental manipulations of contexts associated with specific emotional responses. This may not allow the assessment of the transition from the initial conditions to todays' equilibrium, but could provide insights into how socioecological contexts encourage emotional expression. The effects of historical and present heterogeneity can also be studied in contexts involving the necessity to cooperate and build new, emerging hierarchies in absence of traditional social norms. In sum, we hope a systematic exploration of socioecological variables will help to transcend binary distinctions between East and West, provide better insights into how the lenses of cultural contexts change the way we feel and express emotion, and, eventually, move closer to the 'slow science of the cultural difference' [36].

Conflict of interest statement

Nothing declared.

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References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

1. Matsumoto D, Willingham B: **The thrill of victory and the agony of defeat: spontaneous expressions of medal winners of the 2004 Athens Olympic games**. *J Pers Soc Psychol* 2006, **91**:568-581.
2. Hess U, Beaupré MG, Cheung N: **Who to whom and why – cultural differences and similarities in the function of smiles**. *An empirical reflection on the smile*. The Edwin Mellen Press; 2002:187-216.
3. Tsai J, Ang J, Blevins E, Goernandt J, Fung H, Jiang D, Elliott J, Kölzer A, Uchida Y, Lee Y *et al.*: **Leaders' smiles reflect cultural differences in ideal affect**. *Emotion* 2016, **16**:183-195.
4. Szarota P: **The mystery of the European smile: a comparison based on individual photographs provided by internet users**. *J Nonverbal Behav* 2010, **34**:249-256.
5. Ekman P: **What scientists who study emotion agree about**. *Perspect Psychol Sci* 2016, **11**:31-34.
6. Jack R: **Culture and facial expressions of emotion**. *Vis Cogn* 2013, **21**:1248-1286.
7. Jack R, Garrod O, Schyns P: **Dynamic facial expressions of emotion transmit an evolving hierarchy of signals over time**. *Curr Biol* 2014, **24**:187-192.
8. Lee D, Susskind J, Anderson A: **Social transmission of the sensory benefits of eye widening in fear expressions**. *Psychol Sci* 2013, **24**:957-965.
9. Crivelli C, Jarillo S, Russell J, Fernández-Dols J: **Reading emotions from faces in two indigenous societies**. *J Exp Psychol Gen* 2016, **145**:830-843.
10. Cordaro D, Keltner D, Tshering S, Wangchuk D, Flynn L: **The voice conveys emotion in ten globalized cultures and one remote village in Bhutan**. *Emotion* 2016, **16**:117-128.
11. Kayyal M, Russell J: **Americans and Palestinians judge spontaneous facial expressions of emotion**. *Emotion* 2013, **13**:891-904.
12. Gendron M, Roberson D, van der Vyver J, Barrett L: **Perceptions of emotion from facial expressions are not culturally universal: evidence from a remote culture**. *Emotion* 2014, **14**:251-262.
13. Parkinson C, Walker T, Memmi S, Wheatley T: **Emotions are understood from biological motion across remote cultures**. *Emotion* 2017, **17**:459-477.
14. Crivelli C, Russell J, Jarillo S, Fernández-Dols J: **The fear gasping face as a threat display in a Melanesian society**. *Proc Natl Acad Sci* 2016, **113**:12403-12407.
15. Sauter D, Eisner F, Ekman P, Scott S: **Cross-cultural recognition of basic emotions through nonverbal emotional vocalizations**. *Proc Natl Acad Sci USA* 2010, **107**:2408-2412.
16. Gendron M, Roberson D, van der Vyver J, Barrett L: **Cultural relativity in perceiving emotion from vocalizations**. *Psychol Sci* 2014, **25**:911-920.

17. Sauter D, Eisner F, Ekman P, Scott S: **Emotional vocalizations are recognized across cultures regardless of the valence of distractors**. *Psychol Sci* 2015, **26**:354-356.

18. Gendron M, Roberson D, Barrett L: **Cultural variation in emotion perception is real: a response to Sauter, Eisner, Ekman, and Scott (2015)**. *Psychol Sci* 2015, **26**:357-359.

19. Jack R, Sun W, Delis I, Garrod O, Schyns P: **Four not six: revealing culturally common facial expressions of emotion**. *J Exp Psychol Gen* 2016, **145**:708-730.

20. DiGirolamo M, Russell J: **The emotion seen in a face can be a methodological artifact: the process of elimination hypothesis**. *Emotion* 2017, **17**:538-546.

21. Elfenbein H: **Nonverbal dialects and accents in facial expressions of emotion**. *Emot Rev* 2013, **5**:90-96.

22. Kang S, Lau A: **Revisiting the out-group advantage in emotion recognition in a multicultural society: further evidence for the in-group advantage**. *Emotion* 2013, **13**:203-215.

23. Huwaë S, Schaafsma J: **Cross-cultural differences in emotion suppression in everyday interactions**. *Int J Psychol* 2016 http://dx.doi.org/10.1002/ijop.12283.

24. Matsumoto D, Seung Hee Yoo, Fontaine J: **Mapping expressive differences around the world: the relationship between emotional display rules and individualism versus collectivism**. *J Cross Cult Psychol* 2008, **39**:55-74.

25. •• Rychlowska M, Miyamoto Y, Matsumoto D, Hess U, Gilboa-Schechtman E, Kamble S, Muluk H, Masuda T, Niedenthal P: **Heterogeneity of long-history migration explains cultural differences in reports of emotional expressivity and the functions of smiles**. *Proc Natl Acad Sci USA* 2015, **112**:E2429-E2436.

Evidence linking country-level historical heterogeneity with display rules of openly expressing one's emotions and with the endorsement of bonding functions of smile.

26. Tsai W, Sun M, Wang S, Lau A: **Implications of emotion expressivity for daily and trait interpersonal and intrapersonal functioning across ethnic groups**. *Asian J Psychol* 2016, **7**:52-63.

27. Triandis H: *Individualism & Collectivism*. Westview Press; 1995.

28. Ito K, Masuda T, Man Wai Li L: **Agency and facial emotion judgment in context**. *Pers Soc Psychol B* 2013, **39**:763-776.

29. Brewer P, Venaik S: **Individualism–collectivism in Hofstede and GLOBE**. *J Int Bus Stud* 2011, **42**:436-445.

30. •• Vignoles V, Owe E, Becker M, Smith P, Easterbrook M, Brown R, González R, Didier N, Carrasco D, Cadena M *et al.*: **Beyond the 'east–west' dichotomy: global variation in cultural models of selfhood**. *J Exp Psychol Gen* 2016, **145**:966-1000.

A large-scale investigation of self-construals of people from different countries reveals the limited utility of the independence-interdependence contrast to represent global variation in models of selfhood.

31. Oyserman D: **Culture three ways: culture and subcultures within countries**. *Annu Rev Psychol* 2017, **68**:435-463.

32. Kitayama S: **Culture and basic psychological processes – toward a system view of culture: comment on Oyserman et al. (2002)**. *Psychol Bull* 2002, **128**:89-96.

33. Suh E, Diener E, Oishi S, Triandis H: **The shifting basis of life satisfaction judgments across cultures: emotions versus norms**. *J Pers Soc Psychol* 1998, **74**:482-493.

34. • Hakim N, Simons D, Zhao H, Wan X: **Do Easterners and Westerners differ in visual cognition? A preregistered examination of three visual cognition tasks**. *Soc Psychol Pers Sci* 2017, **8**:142-152.

A failure to replicate the previously reported finding that Asian participants process visual information more holistically than American participants.

35. Brewer P, Venaik S: **The ecological fallacy in national culture research**. *Organ Stud* 2014, **35**:1063-1086.

36. Roepstorff A: **Why am I not just lovin' cultural neuroscience? Toward a slow science of cultural difference**. *Psychol Inq* 2013, **24**:61-63.

37. • Talhelm T, Zhang X, Oishi S, Shimin C, Duan D, Lan X, Kitayama S: **Large-scale psychological differences within China explained by rice versus wheat agriculture**. *Science* 2014, **344**:603-608.

Evidence linking history of farming rice in specific Chinese regions with interdependence and holistic thought in present-day population of these regions. Conversely, farming wheat was associated with independence and analytic thought.

38. Fincher C, Thornhill R, Murray D, Schaller M: **Pathogen prevalence predicts human cross-cultural variability in individualism/collectivism**. *Proc R Soc B* 2008, **275**:1279-1285.

39. Kitayama S, Ishii K, Imada T, Takemura K, Ramaswamy J: **Voluntary settlement and the spirit of independence: evidence from Japan's "northern frontier"**. *J Pers Soc Psychol* 2006, **91**:369-384.

40. Gorodnichenko Y, Roland G: **Individualism, innovation, and long-run growth**. *Proc Natl Acad Sci USA* 2011, **108**:21316-21319.

41. Oishi S: **The psychology of residential mobility: implications for the self, social relationships, and well-being**. *Perspect Psychol Sci* 2010, **5**:5-21.

42. Cohen D: **Cultural variation: considerations and implications**. *Psychol Bull* 2001, **127**:451-471.

43. • Varnum M, Grossmann I: **Pathogen prevalence is associated with cultural changes in gender equality**. *Nat Hum Behav* 2016, **1**:0003.

Two studies using archival data from the United States and the United Kingdom and documenting that decreases in pathogen prevalence predict increased gender equality and slower life history strategies.

44. Putterman L, Weil D: **Post-1500 population flows and the long-run determinants of economic growth and inequality**. *Q J Econ* 2010, **125**:1627-1682.

45. Hofstede G: *Culture's Consequences*. Sage Publications; 2011.

46. Alesina A, Devleeschauwer A, Easterly W, Kurlat S, Wacziarg R: **Fractionalization**. *J Econ Growth* 2003, **8**:155-194.

47. •• Girard J, McDuff D: **Historical heterogeneity predicts smiling: evidence from large-scale observational analyses**. In *Proceedings of the IEEE International Conference on Automatic Face & Gesture Recognition*. 2017.

Recent demonstration, using a sample of 866,726, that historical heterogeneity explains the largest unique variance in spontaneous smiling behavior across cultures, compared to other culture variables.

48. Niedenthal P, Mermillod M, Maringer M, Hess U: **The Simulation of Smiles (SIMS) model: embodied simulation and the meaning of facial expression**. *Behav Brain Sci* 2010, **33**:417-433.

49. Gunnery S, Ruben M: **Perceptions of Duchenne and non-Duchenne smiles: a meta-analysis**. *Cogn Emot* 2015, **30**:501-515.

50. Baudrillard J: *America*. Verso; 2010.

51. Krys K, Hansen K, Xing C, Szarota P, Yang M: **Do only fools smile at strangers? Cultural differences in social perception of intelligence of smiling individuals**. *J Cross Cult Psychol* 2014, **45**:314-321.

52. Krys K, Vauclair CM, Capaldi C, Lun V, Bond M, Domínguez-Espinosa A, Torres C, Lipp O, Manickam L, Xing C *et al.*: **Be careful where you smile: culture shapes judgments of intelligence and honesty of smiling individuals**. *J Nonverbal Behav* 2015, **40**:101-116.

53. Elfenbein H, Ambady N: **On the universality and cultural specificity of emotion recognition: a meta-analysis**. *Psychol Bull* 2002, **128**:203-235.

54. •• Wood A, Rychlowska M, Niedenthal P: **Heterogeneity of long-history migration predicts emotion recognition accuracy**. *Emotion* 2016, **16**:413-420.

A meta-analysis revealing that expressions of emotion displayed by people from historically heterogeneous countries are easier to recognize than emotions communicated by people from homogeneous countries.

55. • Yu H, Garrod O, Schyns P: **Perception-driven facial expression synthesis**. *Comput Graph* 2012, **36**:152-162.

Introduction of a data-driven procedure to model the physical appearance of members of perceptual categories.

56. Dotsch R, Todorov A: **Reverse correlating social face perception**. *Soc Psychol Pers Sci* 2012, **3**:562-571.

57. Khooshabeh P, Dehghani M, Nazarian A, Gratch J: **The cultural influence model: when accented natural language spoken by virtual characters matters**. *AI Soc* 2014, **32**:9-16.

58. Diamond J: **Reversals of national fortune, and social science methodologies**. *Proc Natl Acad Sci USA* 2014, **111**:17709-17714.