Is Perceived Expressivity of Game Players a Cue to Game Outcome Prediction Accuracy?

Phoebe Mui (h.c.mui@uvt.nl)

Martijn Goudbeek (m.b.goudbeek@uvt.nl)

Marc Swerts (m.g.j.swerts@uvt.nl)
Tilburg Center for Cognition and Communication (TiCC), School of Humanities, Tilburg University
PO Box 90153, 5000 LE, Tilburg, The Netherlands

Abstract

Games can be won or lost, and the outcome of the game often determines our facial expression. Thus, game players' facial expression possibly provides information about the game outcome. The connection between such nonverbal cues and accuracy at which game outcome could be deduced is investigated in a perception experiment. Facial expressions of Chinese and Dutch children playing a game, either alone or in pairs, were shown to Chinese and Dutch judges who had to evaluate their expressivity and game outcome. No one-to-one mapping between perceived expressivity and guessing accuracy across conditions was revealed. A positive correlation was observed between expressivity and accuracy for both Chinese and Dutch children playing in pairs as well as alone, but only when they were winning. In fact, nonexpressivity was consistently interpreted by judges as a signal for losing. Our findings contribute to the identification of conditions in which expressivity can reliably aid perception.

Keywords: Expressivity; perception; facial expression; perception accuracy

Introduction

We often form impressions about what has happened to someone based on cues he or she displays. Suppose two people come out of a job interview, one smiling and one frowning. Without any other information, we can still reasonably infer from the smile that the interview went well for the former candidate, whereas the frown suggests that the interview did not go smoothly for the latter candidate. In situations as such, nonverbal cues expressed by a person are informative signals of the event experienced by the person. However, in real life, facial displays of people are often more nuanced than those described in the example, and are probably influenced by a number of factors.

This paper investigates the extent to which expressivity of a person allows other people to correctly judge what event this person has experienced. We regard expressivity as the number of cues, as well the intensity of the cues, a sender provides. In our study, we examine spontaneous nonverbal displays of children who were playing a game. We investigate the link between how expressive children were perceived to be and how accurately their game outcomes were inferred in different conditions. In doing so, we aim to identify circumstances under which perceived expressivity reliably aids inference about game outcomes.

Displays of Winning and Losing

Previous work found that different signals exist for winning and losing. In their study on expressions of Olympic athletes, Matsumoto and Willingham (2006) identified the Duchenne smile (Ekman, Davidson, & Friesen, 1990) as the distinguishing facial cue of victory. On the basis of this finding, we find it plausible to assume that prototypical cues of victory can be correctly interpreted as signals of winning. However, no unique expression of defeat was found. Displays of athletes who lost the medal match were most commonly characterized by sadness, *nothing*, or contempt. Recently, Furley and Schweizer (2014) showed that people are capable of deducing from the nonverbal behaviour of athletes whether they are trailing or leading in a sports match. However, neither study reported any assessment of expressivity of the displays, nor results of any perception test. Hence, these studies shed little light on how perceived expressivity is linked to game outcome prediction, as well as how an absence of cues is interpreted. Is an absence of facial cues considered nonexpressive? If so, are people more likely to interpret this nonexpressivity as a signal of winning or of losing? We seek to answer these questions in our study by including an assorted array of nonverbal displays, ranging from not expressive at all to very expressive. We also assess perceived expressivity and guessing accuracy, and–importantly–the relation between them.

Effect of Presence of Others

Consider the example of job candidates again. What would happen if the candidates immediately ran into a good friend after the interview? One could reasonably expect a change in their nonverbal expressions. It is not hard to imagine that the smiling candidate might beam radiantly with joy, so as to show the friend how well the interview went. The frowning candidate might sulk even more, as a means to vent his or her dissatisfaction.

Indeed, in line with this intuitive conjecture, it has been found that the expression of facial cues in gameplay depends on the presence of others. Shahid, Krahmer, and Swerts (2008) showed that game outcomes of children who were playing in pairs were more accurately judged than those who played alone. This factor of co-presence is also investigated in our study.

Effect of Culture

Cultural display rules (Ekman & Friesen, 1969) are societal expectations governing what expressive behaviour is deemed appropriate, which may vary across cultures. Some researchers argue that we are better at perceiving expressions of people from our own cultural group (Elfenbein & Ambady, 2002; Elfenbein, Beaupré, Levesque, & Hess, 2007), whereas others have not observed such an ingroup advantage (Matsumoto, Olide, & Willingham, 2009). Shahid et al. (2008) conducted their study with Pakistani and Dutch children, and Pakistani and Dutch judges. No ingroup advantage was found; however, judges were more accurate in judging Pakistani children than when judging Dutch children. The authors went on to claim that Pakistani children were more expressive than Dutch children. However, they could not explicitly state this claim because expressivity was not assessed in their study.

As we are also interested in identifying groups of people for which expressivity might serve as an informative cue of game outcome, our study is conducted with two cultural groups: Chinese and Dutch. These two groups are chosen as higher self-reported emotion expressivity scores have been recorded for Dutch than for Chinese (Matsumoto et al., 2008). Moreover, differences between East Asians and Western Caucasians in internal representations of facial expressions (Jack, Caldara, & Schyns, 2012), and in cognition and emotion in general (Markus & Kitayama, 1991), have been observed. Chinese and Dutch also differ on other cultural characteristics (e.g., Bond et al., 2004; Gelfand et al., 2011; Hofstede, 2001) which may influence facial expression and perception, and yield data that can be compared to previous work with Pakistani and Dutch.

Present Study

The overarching goal of our study is to determine if people could correctly deduce a game outcome from the facial expressions of the game player. We elicit nonverbal displays of victory and defeat from Chinese and Dutch children who either play a game alone or in pairs. Subsequently, we use these nonverbal displays as stimuli in a perception study. We ask Chinese and Dutch judges to rate the expressivity of children, and to indicate whether the children had won or lost. Finally, additional correlational analyses are conducted to identify situations in which perceived expressivity of game players is tied to guessing prediction accuracy.

Elicitation Task

We obtained video recordings of children participating in a number guessing game. To investigate whether expressivity would depend on game outcome, we ensured that children experienced both winning and losing. Moreover, children played the game either alone or in pairs, allowing us to examine the possible effect of co-presence on expressivity.

Method

Participants

Fifty-five Chinese (34 male) and 31 Dutch (23 male) children took part in our study, with the informed consent of their parents and school teachers. The Chinese children were 8-year-old pupils at a school in Suzhou, China. The Dutch children were 8-year-olds attending a school in Tilburg, the Netherlands.

Task and Material

We used a game paradigm to elicit expressions associated with winning and losing. The game was a simple number guessing game consisted of six rounds, set up in Microsoft PowerPoint. In each round, six cards were displayed on the screen but only the number on the first card was revealed. The task of participants was to guess whether the number on the next card would be higher or lower than the number currently shown. They were told that the numbers could range from *one* to *ten*, and that a round would be considered a win only when all guesses within that round were correct. A round would be considered a loss and would end right away whenever an incorrect guess was made; an incorrect guess made for the last card of the round resulted in a completed round that counted as a loss, whereas an incorrect guess made for any card before the last card resulted in an *incomplete* round that also counted as a loss. As explained in the next section, only completed rounds, both winning and losing, were selected for the perception experiment.

Unbeknownst to participants, we designed the game in such a way that both wins and losses were inevitable. The level of difficulty for cards two to five were designed to be easy (e.g., a card showing the number *nine* would be followed by a lower number), based on sheer consideration of the possible range of numbers (*one* to *ten*). In each round, given that guesses made for cards two to five were correct, the guess made for the sixth card (i.e., the last card) would determine whether participants won or lost that round. To ensure that both wins and losses were likely for all participants, we manipulated the number shown on the last card in each round. In the winning variant, the number on the last card was a likely number given the preceding number (e.g., *eight* preceded by *two*). On the contrary, in the losing variant, the number on the last card was unlikely given the preceding number (e.g., *one* preceded by *two*). This manipulation resulted in at least two winning and two (completed) losing rounds for all participants.

Procedure

Participants were randomly assigned to one of the two conditions: playing alone (13 Chinese, 15 Dutch), or playing with a same-gender classmate of their choice (21 Chinese pairs, 16 Dutch pairs). They were seated in front of a computer screen, above which a camcorder was placed.

An experimenter gave instructions to participants in their native language (Chinese or Dutch). Once participants made their guess, the number on the next card would be revealed, along with a tone which signalled whether their guess had been correct or not. No time constraint was imposed; the task was over as soon as six rounds of the game had been completed. Participants who played in pairs could interact with their partner if they so wished. All participants were videotaped throughout the task.

Results

Video Recordings

The elicitation task described above gave rise to a considerable number of video recordings, which would be used in a subsequent perception experiment. Of all the recordings available, we first excluded those obtained from *incomplete* (losing) rounds. After all, expressions from participants who lost the round due to the last guess (a completed round) may not be comparable to those who lost due to, for example, the second guess (an *incomplete* round). Moreover, we decided to retain only the recordings obtained from the second winning round and the second losing round. This was done to reasonably rule out unfamiliarity and boredom with the game as a confounding factor for the expressions displayed by participants. Such a selection resulted in two recordings per participant or pair; 56 recordings from participants who played alone (26 Chinese, 30 Dutch) and 74 from pairs (42 Chinese pairs, 32 Dutch pairs) were retained.

We edited the length of the recordings such that the onset showed the moment at which participants had just guessed what the number on the last card was. The recordings ended with the moment at which participants' response to seeing the game outcome had subsided. On average, a video fragment lasted 5 seconds. Moreover, for recordings obtained from pairs, we randomly selected one participant from the pair and cropped the recordings such that only one participant was visible; the resulting recordings appeared to be the same as those obtained from participants playing alone. Audio was also removed from all recordings. Examples of the stimuli in stills are shown in Figure 1.

Figure 1: Stills of portrayals. From left to right: Chinese, loss; Dutch, loss; Chinese, win; Dutch, win.

Perception Test

The aforementioned video recordings were used as stimuli in a perception test. After watching each recording, Chinese and Dutch judges had to indicate whether they thought the child had won or lost the game, and how expressive they considered the child to be.

Method

Participants

Judges were 109 Chinese and 108 Dutch university students. The Chinese judges were undergraduates at Nanjing University, China, who took part in the study in exchange for 50 Chinese Yuan (about 6 Euros). The Dutch judges were undergraduates at Tilburg University, the Netherlands, who took part for partial course fulfilment.

Material and Procedure

Video recordings obtained from the elicitation task, edited as described previously, served as stimuli for the current perception test. The potential role of cultural background in expressivity and perception was of key interest to our research. Therefore, we ensured that recordings of Chinese children were shown to both Chinese and Dutch judges in the perception test; recordings of Dutch children were shown in the same fashion.

Judges were seated at individual computers. After having given informed consent, they learned that they would watch video recordings of children who were either winning or losing a game. After watching each recording, they needed to answer two questions: whether the child had won or lost (forced choice), and how expressive the child was on a scale from 1 to 7 (1 = *not expressive at all*; 7 = *very expressive*). All instructions were provided in the native language of the judge (Chinese or Dutch).

Judges from both backgrounds watched recordings of either Chinese or Dutch children throughout the test, the assignment of which was random. Four video recordings served as practice materials, which were not used as stimuli in the actual experiment. As soon as judges completed the practice and indicated that the task was clear, they were left alone to complete the perception test. All recordings were preceded by a number that appeared for two seconds on the screen. When the recording was over, judges were given ten seconds to indicate their responses to the two questions. The entire perception test was set up in Microsoft PowerPoint; the muted recordings played automatically in the middle of the screen against a black background.

Results

Our study employed a mixed design with four factors, namely (1) nationality of children in recordings, (2) nationality of judges who watched the recordings, (3) co-presence: whether children played alone or in pairs, and (4) game outcome: whether children in recordings won or lost. The first two were between-subject factors, the latter two within-subject. Dependent variables were mean guessing accuracy (in percentages) and mean perceived expressivity (on a scale from 1 to 7).

Descriptive statistics

Descriptive statistics concerning the between-subject factors are shown in Table 1. Judges did not seem to give higher perceived expressivity ratings to children of the same nationality. However, nationality played a role in how accurately judges made their guesses. Chinese who watched recordings of Chinese children (*M* = 65.1%, *SE* = 0.95) made more accurate guesses than Chinese who observed Dutch children (*M* = 61.6%, *SE* = 0.52), *t* (107) = 3.09, *p* = .003, Cohen's *d* = 0.74. Likewise, an ingroup advantage was observed for Dutch judges. Dutch judges who observed Dutch children (*M* = 68.5%, *SE* = 0.53) were more accurate than Dutch who judged Chinese children (*M* = 66.0%, *SE* = 0.88), *t* (106) = 2.8, *p* = .005, Cohen's *d* = 0.58. More thorough analyses that take within-subject factors into account are reported below.

Table 1: Means, standard errors, and 95% confidence intervals of perceived expressivity and guessing accuracy as a function of the between-subject independent variables.

Nationality of judge	Nationality of child	*Mean*	*SE*	95% CI
		Perceived Expressivity		
Chinese	Chinese	3.88	0.11	3.66 - 4.10
	Dutch	4.17	0.06	4.06 - 4.29
Dutch	Chinese	3.89	0.10	3.69 - 4.09
	Dutch	3.97	0.06	3.85 - 4.09
		Guessing Accuracy (%)		
Chinese	Chinese	65.1	0.95	63.3 - 67.0
	Dutch	61.6	0.52	60.6 - 62.6
Dutch	Chinese	66.0	0.88	64.3 - 67.8
	Dutch	68.5	0.53	67.4 - 69.5

Perceived Expressivity

A 2 (nationality of child) x 2 (nationality of judge) x 2 (co-presence) x 2 (game outcome) mixed ANOVA was conducted, revealing a number of significant effects. As shown in Figure 2(a), game outcome interacted with co-presence, *F* (1, 213) = 97.93, *p* < .001, η^2_p = .32. Overall, judges regarded children who lost (*M* = 4.02, *SE* = .048) as more expressive than those who won (*M* = 3.94, *SE* = .042), *F* (1, 213) = 10.68, *p* = .001, η^2_p = .048. Judges also gave higher expressivity ratings to children who played in pairs (*M* = 4.77, *SE* = .043) than to those who played alone (*M* = 3.19, *SE* = .051), *F* (1, 213) = 1845.65, *p* < .001, η^2_p = .90. However, as indicated in the interaction, children who lost were considered more expressive than children who won only when they played alone; winning or losing did not make a difference for expressivity scores given to pairs.

In addition, a significant main effect of the nationality of child was observed. Overall, Dutch children (*M* = 4.07, *SE* = .043) were considered more expressive than Chinese children (*M* = 3.89, *SE* = .075), *F* (1, 213) = 4.52, *p* = .035, η^2_p = .021, the effect of which was relatively weak.

Guessing Accuracy

A mixed ANOVA was also conducted on mean guessing accuracy, with the same independent variables as before. Two significant interactions were observed. First, the two nationality factors interacted with each other, *F* (1, 213) = 16.44, *p* < .001, η^2_p = .07. Overall, Dutch judges (*M* = 67.3%, *SE* = 0.51) were better at guessing than Chinese judges (*M* = 63.4%, *SE* = 0.54), *F* (1, 213) = 27.45, *p* < .001, η^2_p = .11. However, as suggested earlier, an ingroup advantage seemed to exist. The interaction showed that Dutch judges were better at guessing than Chinese judges, but this advantage was more pronounced for guesses about Dutch children than about Chinese children.

Second, co-presence interacted with game outcome, *F* (1, 213) = 648.33, *p* < .001, η^2_p = .75, the effect of which was strong. Overall, judges made more accurate guesses for children who played in pairs (*M* = 73.0%, *SE* = .57) than for those who played alone (*M* = 57.6%, *SE* = .48), *F* (1, 213) = 429.70, *p* < .001, η^2_p = .67. Judges were also more accurate when judging children who lost (*M* = 75.4%, *SE* = .78) than those who won (*M* = 55.2%, *SE* = .70), *F* (1, 213) = 248.34, *p* < .001, η^2_p = .54. However, as shown in Figure 2(b), accuracy made for children who lost was higher than that for children who won only in cases where children played alone; game outcome did not make a difference in accuracy for children who played in pairs. No other significant main effect was observed.

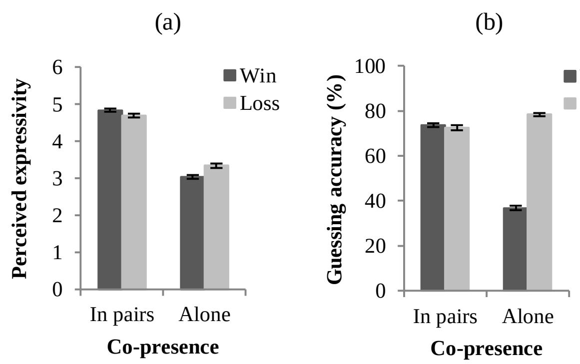

Figure 2: (a) Perceived expressivity, and (b) guessing accuracy, as a function of co-presence and game outcome. Error bars represent standard errors.

Discussion

Our findings show that spontaneous nonverbal cues do indeed depend on the presence of others, as well as on the event experienced. These, in turn, play a part in how correctly cues can be interpreted by others. Consistent with earlier work conducted with Dutch and Pakistani (Shahid, Krahmer, & Swerts, 2008), we found that children who played in pairs and children who lost were perceived as more expressive, compared to those who played alone and those who won.

To directly assess the relation between guessing accuracy and expressivity that was conjectured by Shahid et al., we made a point of creating a separate measure of perceived expressivity. We found that Dutch children were judged as more expressive than Chinese children overall, and that the two groups *did not* differ in how accurately they were judged; children's nationality had no effect on guessing accuracy. Shahid et al., however, concluded that Pakistani children were more expressive just because the accuracy was higher for Pakistani children than Dutch. Results from our study are in line with previous studies which showed that self-reported expressivity scores were higher for Dutch than for Chinese (Matsumoto et al., 2008).

Interestingly enough, results obtained in our perception study for the two dependent measures were largely in parallel. When judges gave high ratings of perceived expressivity, guessing accuracy appeared to be high as well. On the basis of this mapping, one could speculate a positive relationship between perceived expressivity and guessing accuracy. It could well be that judges made correct guesses when they perceived children to be expressing cues informative for guessing. However, the neat mapping from expressivity to accuracy was less discernible for recordings of children playing alone. As indicated in Figure 2(b), the lowest and highest accuracy scores (36.79% and 78.36% respectively) were observed for recordings of children who played alone; yet, expressivity ratings of these recordings were less extreme and did not seem to correspond to the accuracy scores.

Why, then, would expressivity appear to co-occur with accuracy only in some cases? As an attempt to further explore the relation between perceived expressivity and accuracy, we conducted additional analyses of the video recordings.

Correlational Analyses

Analyses of data obtained from the perception study were conducted with *judge* as the unit of observation. Intrigued by the perplexing relation between expressivity and guessing accuracy, we decided to restructure the data for conducting analyses with *video recording* (i.e., portrayal) as the unit of observation. Our goal was exploratory in nature; we would like to delineate the specific conditions under which expressivity and accuracy were related, and to understand what factors contributed to this relation.

Method

Data obtained from the perception study were transposed. Rows and columns were switched such that *video recording* was the unit of analysis; relations between ratings and guesses for the recordings were the variables of interest. The sample consisted of 130 video recordings (68 portrayals of Chinese children, 62 portrayals of Dutch children).

Results

Nonparametric correlational analyses between perceived expressivity and accuracy were carried out, as expressivity was measured on an ordinal scale. Overall, a significant positive association was observed between perceived expressivity and accuracy, Spearman's $\rho = .42$, $p < .001$. Game outcomes of video recordings that scored higher on expressivity were also more accurately guessed. Upon closer inspection, we found that this relationship did not significantly differ between recordings of Chinese (Spearman's $\rho = .50$, $p < .001$) and Dutch (Spearman's $\rho = .32$, $p = .012$) children, $z = 1.23$, *ns*. However, the relationship between expressivity and guessing accuracy only held for recordings of children playing in pairs (Spearman's $\rho = .57$, $p < .001$) but not alone (Spearman's $\rho = .19$, *ns*). It was also observed only for recordings of children who won (Spearman's $\rho = .80$, $p < .001$) but not of recordings of children who lost (Spearman's $\rho = -.10$, *ns*).

Next, we computed the analyses separately for recordings of children playing in pairs and alone. Interestingly, for both kinds of recordings, expressivity did correlate with guessing accuracy, but only when the children were winning (in pairs: Spearman's $\rho = .81$, $p < .001$; alone: Spearman's $\rho = .65$, $p < .001$; $z = 1.27$, *ns*). No significant correlation between expressivity and accuracy was observed for recordings of children who lost.

Discussion

Based on the perception study which showed that the patterning of expressivity ratings seemed to correspond to the patterning of guessing accuracy in most conditions, we hypothesised a positive relation between these two variables. This hypothesis was investigated in a correlational analysis, assessing correlation between perceived expressivity and guessing accuracy for our whole sample and for the different subgroups based on culture (Chinese versus Dutch), co-presence (playing in pairs versus playing alone) and game outcome (winning versus losing).

Overall, perceived expressivity had a strong positive association with accuracy. However, this relationship was absent for children who lost. We speculate that this could be explained by the preferred guess judges opted for (i.e., a bias in their judgment) in case of an absence of cues, the implications of which are explained below.

The positive correlation between perceived expressivity and accuracy for children who were winning implies that the less expressive a child was regarded to be, the more likely judges were to incorrectly guess that the child was losing. In other words, an absence of cues was seen as a signal of losing by judges; Matsumoto and Willingham (2006) also found that a sizeable number of Olympic athletes who lost a medal match displayed nothing. We believe that judges also had this guessing preference when judging children who were losing. A losing child who was perceived as expressive (and thus signalling losing) was likely to be correctly judged as losing. However, a losing child who was perceived as nonexpressive (i.e., signalling neither winning nor losing) was *also* likely to be correctly judged as losing. This preference by judges explains the absence of a positive correlation between expressivity and accuracy for children who were losing.

Why is an absence of cues considered a signal of losing? Matsumoto and Willingham (2006) believed that athletes who showed nothing after having lost the match were controlling their facial displays intentionally, so as to not signal their disappointment at the defeat. Indeed, athletes participating in the Olympics are in intense public spotlight. No matter how upset they might be, they still feel the need to show good sportsmanship; openly displaying disappointment or anger may fare less well for their public image. Following this line of reasoning, it could well be that people have learned to associate a lack of expression from others with a negative game outcome. After all, there appears to be little harm in expressing one's joy when one wins a game, whereas more is at stake when expressing disappointment upon losing.

In our perception test, judges were faced with a forced choice between *winning* and *losing*. In experiments on judgment of emotion expressions, a neutral response option is often available (Bänziger, Mortillaro, & Scherer, 2010). What if a third option indicating uncertainty (such as "*I don't know*") was also available in our study? If nonexpressivity is generally perceived and accepted as a reliable signal of losing, children showing no particular expression would still be regarded as having lost the game. However, if people were to find nonexpressivity to be of little informative value, they would probably opt for "*I don't know*" instead of "*losing*". Additionally, measures of confidence could be included. If judges would also indicate how confident they are with their judgment, relationships between perceived expressivity, prediction confidence, and prediction accuracy could be examined. These are issues we aim to address in future studies.

Conclusion

Results from our perception study and correlational analyses provide evidence for a relationship between expressivity of game players and prediction accuracy of game outcome. We have shown that expressivity and prediction accuracy are related to a number of factors, namely cultural background, co-presence, and the game outcome. We have also shown that high expressivity serves as a valuable cue of game outcome. Winners who are expressive are often correctly identified as winning, and losers who are expressive are also correctly identified as losing. Importantly, low perceived expressivity is seen as a signal for losing. Winners who are nonexpressive are likely to be (incorrectly) regarded as losing, and so are losers who are nonexpressive.

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