# On the multifaceted Nature of Prejudice: Psychophysiological Responses to Ingroup and Outgroup Ethnic Stimuli.

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**3 authors**, including:

Michaël Dambrun
Université Clermont Auvergne, UCA


Serge Guimond
Université Clermont Auvergne

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## ON THE MULTIFACETED NATURE OF PREJUDICE: PSYCHOPHYSIOLOGICAL RESPONSES TO INGROUP AND OUTGROUP ETHNIC STIMULI

Michaël Dambrun
Université Blaise Pascal, CNRS, France and McGill University, Canada

Gérard Desprès
Université Blaise Pascal, France and URH, INRA, France

Serge Guimond
Université Blaise Pascal, CNRS, France

### ABSTRACT

*The goal of this study was to provide new insights about psychophysiological evaluation of the intensity and valence of responses to ethnic-related stimuli. ANS activity (through heart rate, heart period variability and electrodermal activity), facial EMG and respiratory activity (RA) were explored simultaneously among French participants during the presentation of an ingroup member (French) and an outgroup member (Arab) on a computer screen. While all physiological indicators were sensitive to the emotional intensity of ethnic stimuli, only right facial EMG and RA were affected by emotional valence. Furthermore, analyses revealed that, during the outgroup target exposure, decreases in parasympathetic activity were a source of heart rate acceleration. Finally, a factor analysis confirmed that cardiac ANS activity on the one hand, and facial EMG and RA on the other, corresponded to two categories of implicit affective prejudice measures that were distinct from a third category constituted by self-report.*



### INTRODUCTION

Social psychologists have long been concerned with the development of valid measures of prejudice. Prejudice can be defined as an unjustifiable negative attitude toward a group and its

individual members (Allport, 1954; Myers, 1993). Self-report measures of prejudice based on introspection have shown some limitations (Greenwald & Banaji, 1995; Nisbett & Wilson, 1977). In fact, because explicit attitudes operate in a conscious fashion and are almost entirely under the control of the respondent, nothing prevents a racist individual from reporting positives racial attitudes on a questionnaire (see Fazio, Jackson, Dunton, & Williams, 1995; Sigall & Page., 1971). Widespread concerns about the validity of explicit attitudes has stimulated the development of less reactive measures of intergroup attitudes. While priming procedures (see for a recent review, Brauer, Wasel & Niedenthal, 2000) assess the cognitive component of intergroup attitudes, psychophysiological methods assess their affective component (Guglielmi, 1999). In light of the key role attributed to affect in current conceptualizations of prejudice (Hilton & von Hippel, 1996; Mackie & Smith, 1998), psychophysiological investigations are needed to understand the multifaceted nature of prejudice.

At least four components of intergroup attitudes can be distinguished (see Guglielmi, 1999): the cognitive explicit component (assessed by explicit measures of stereotyping), the affective explicit component (assessed by explicit prejudice scales), the cognitive implicit component (assessed by priming measures; e.g. Lexical Decision Task), and the affective implicit component (assessed by psychophysiological measures; e.g. EMG). Several psychophysiological approaches have been found valuable for assessing the intensity and/or valence of emotional responses like prejudice (see for a recent review, Guglielmi 1999). Emotional intensity refers to the general arousal elicited by a stimulus. But, emotional events can also be differentiated on the basis of whether they are positive or negative (pleasant vs. unpleasant,…). These valenced emotional events differ in the degree to which they arouse the individual (Bradley, 2000). In the context of prejudice, while some psychophysiological measures seem to assess only the intensity of affective reactions, others seem able to differentiated both valence and intensity. In the present study, we distinguish between three kinds of psychophysiological measures to assess prejudice: (1) Autonomic Nervous System (ANS) based measures [1] ; (2) facial electromyographical activity (EMG); and, (3) respiratory activity (RA). For each psychophysiological indicator, we submit and test specific hypotheses.

ANS activity based investigations reveal generally that outgroup targets illicit more electrodermal activity (Rankin & Campbell, 1955) and cardiac activity (Einarsen, & al., 1991; Vrana & Rollock, 1996, cited by Jones, 1997) than ingroup targets. Though it is quite accepted that electrodermal activity does index only emotional intensity, it seems that cardiovascular reactivity can index a variety of emotional and motivational states such as challenge and threat appraisals, effort mobilization and disengagement, and appetitive versus aversive states (see Blascovich & Tomaka, 1996; Blascovich & Mendes, 2000; Smith & Gerin, 1998; Wright & Kirby, 2001). For example, Blascovich, Mendes, Hunter, Lickel & Kowai-Bell (2001) reveal that perceivers interacting with stigmatized partners exhibited cardiovascular reactivity consistent with threat when compared with participants interacting with nonstigmatized partners, who exhibited challenge reactivity. However, it cannot be inferred that those who exhibited cardiovascular threat responses are those who are the most prejudiced. In fact, several research studies suggest that both electrodermal and cardiovascular responses to ethnic-related stimuli are not significantly related to participant's explicit prejudice level as measured by self-reports (see for a review, Guglielmi, 1999). In other words, ANS measures seem to be a better indicator of intergroup anxiety or threat than of evaluative direction of responses to ethnic-related stimuli.

Although all the research on the autonomic differentiation of prejudice as an emotion has focused on the sympathetic division of the ANS, Porges (1991, 1995) has argued that parasympathetic activity may modulate expression and regulation of emotion. In fact, Quigley and Bernston (1990) have demonstrated that heart rate acceleration is larger to an aversive stimulus than to a low-intensity stimulus, not because of differential sympathetic activity but because parasympathetic activity decreases with high-intensity stimulation. This suggests a new approach to physiologically-based assessment of prejudice, one in which not only sympathetic but also, *parasympathetic activity* are considered. In contrast to previous research, this study investigates ANS activity both through heart activity and a heart period variability index of parasympathetic activity as well as through electrodermal activity, a well recognized index of sympathetic activity (Wallin, 1981). Using this methodology, we propose to test the following hypotheses: 1) Participants will show greater heart rate and electrodermal activity while exposured to an outgroup target stimulus than during exposure to an ingroup target stimulus; but they will also show, following Quigley et al. (1990), a lower parasympathetic activity during outgroup target exposure than during ingroup target exposure (i.e. target ethnicity effect). (2) Because decrease in parasympathetic activity is a source of heart rate acceleration, the heart rate target ethnicity effect should disappear when parasympathetic activity is statistically controlled. (3) The participant's prejudice level, as measured by self-report, is not expected to moderate the effect of the target's ethnicity on ANS activities.

Contrary to ANS activity based measures, facial EMG activity seems to be sensitive to both affective valence and intensity (Caccioppo, Petty, Losch, & Kim, 1986; Guglielmi, 1999, for a review). Regarding prejudice, Vanman, Paul, Ito and Miller (1997) revealed that, in United States, White participants show greater right corrugator supercilli muscle activity during the presentation of slides with Black confederates than during the presentation of slides with White condederates. Moreover, the more participants were prejudiced toward Blacks, as measured by a questionnaire, the more this EMG bias was displayed. Following Vanman et al.(1997), we predict a greater corrugator activity when respondents are exposed to an outgroup member than during exposure to an ingroup member, and this should be a function of the participant's prejudice level, as measured by self-reports.

Finally, several studies have focused on respiratory activity (RA) during emotional expression, but the impact of racial bias on this physiological indicator has been relatively overlooked. Recently, Boiten (1998) conducted a study to examine affect-related respiratory responses during film scenes. This experimental work confirmed several investigations mostly dating from the beginning of the century (Feleky, 1914; Stevenson & Ripley, 1952), showing that emotion affects respiration. More specifically, Boiten (1998) found that disgust is linked to a prolongation of inspiratory pauses, which gets translated into a decrease of the RA. Furthermore, ratings of disgust are negatively correlated with minute ventilation and inspiratory flow, suggesting that RA is sensitive to both emotional valence and intensity. On the basis of this study, we propose the following hypothesis: if outgroup members elicit a negative emotional state like disgust, we can predict that RA of participants will be lower during the presentation of an outgroup member than during the presentation of an ingroup member, and this should be a function of the participant's prejudice level as measured by self-reports.

In sum, we expect facial EMG and RA to be sensitive to both the emotional intensity and valence of responses to ethnic-related stimuli, whereas ANS activity based measures should give information about intensity (i.e. intergroup anxiety), but should not discriminate the evaluative direction of responses to ethnic-related stimuli (i.e. positive vs. negative intergroup attitudes). In other words, the above hypotheses lead to the prediction that when factor analyzed, responses to ethnic target stimuli would result in three factors with one factor representing ANS activity based measures, one factor representing facial EMG and RA and one factor representing explicit self-reports.

To test these hypotheses, we compared cardiac and electrodermal activities, facial EMG and RA of French participants during the presentation of an ingroup member (French) vs. an outgroup member (Arab).



## METHOD

### Participants and Design

Forty-one French students (22 women and 19 men) between 21 and 26 years of age served as participants in a target ethnicity (Arab vs. French) within-subjects design. All participants were four year students in science at the Blaise-Pascal University (Clermont-Ferrand, France).

### Stimulus Materials

During the experimental administration of this task, participants were seated at a distance of approximately 50 cm from a computer screen. Instructions were always presented on the screen. Participants were exposed, sequentially, to two stimulus-individuals: "Sebastien" (French) vs. "Rachid" (Arab) on a PowerBook G3 computer screen. At the beginning of the experiment, respondents read about details of the study on their computer screen. When participants were ready, they had to press the key labeled "start" to begin the task. First, the target name ("Sébastien" vs. "Rachid") appeared on the screen for 5 seconds. Then the screen went blank. After 10 seconds, a screen announced the brief presentation of the target portrait. After a brief exposure to the portrait [2], the screen went blank for 10 seconds. A screen with explanations about the interactive imagination task followed immediately (10 seconds). The following scenario was proposed: "Imagine you need to cooperate with "Sébastien" (vs. "Rachid") to prepare an oral presentation". When the stimulus "+" appeared on the screen, participants had to start the imagination activity. When this stimulus disappeared (after 10 seconds), participants heard a sound which was a signal that they were stop the imagination task. Then, using the computer keypads, participants had to evaluate whether the target was likable using a 7-point scale, which ranged from - 3 (not at all) to + 3 (completely). Immediately following the first rating, participants had to evaluate, on a 7-point scale range from – 3 (not at all) to + 3 (completely), whether the target was clever. These ratings served as explicit self-report measures of prejudice. Before the experimental session, in order to train the participants and habituate them to the procedure, a training task using the same procedure (i.e. name, portrait, imagination

task and evaluation task) was used but the stimulus was different (i.e. a woman). Participants were alone during all phases of the study.

**Procedure**

To reduce apprehension about participating in the study and to attenuate suspicion bias, the study was presented as part of a practical lecture on psychophysiological recording. All students agreed to participate. Using this framework, we chose to use two self-report measures - likeability and cleverness. We didn't use classically explicit prejudice scales (e.g. modern racism scale; McConahay, Hardee & Batts, 1981), because it has been shown that such scales tend to increase respondents' awareness that the study deals with prejudice and this knowledge can affect participants reactions and responses (Fazio & al., 1995). We especially wanted to control for that awareness since we were measuring physiological responses and also because this was an initial study. Indeed, at the end of the study, no participants revealed any suspicions about the study. As far as the participants are concerned, we recorded *no awareness* that the study was dealing with prejudice.

**Data recording and data reduction**

Two rooms were used for the experiment. The participants were in a room which was kept at normal temperature (20-22°C). Physiological responses were monitored in a separate room. More specifically, during the two experimental exposures (French vs. Arab target), electrocardiograms (ECG), skin potential responses (SPR), facial EMG and respiratory activities (RA) were recorded using MacLab S (AD Instruments, UK, www. adinstruments.com) at a sampling frequency of 1000 Hz. Tracking was done using a Macintosh G3. Electric signals for ECG, SPR and EMG were amplified by MacLab ML 132 Bio Amp Front-end Signal conditioners.



*Baseline*

Prior to the task, all the parameters were recorded for 5 minutes. During this period, participants were alone and instructed to relax.

*Cardiac Activity*

Electrocardiogram (ECG) responses were measured using adhesive electrodes (3M Red Dot , ref. 2248 ) that were glued to the right mid clavicle and lower left rib cage, in correspondence with D II Eintoven’s derivation. The ECGs were analysed using A.D. Instruments Chart software. The specialised HRV extension package of this software was used. This extension is designed to compute a table of interbeat intervals (RR intervals) from ECG data recorded with Chart software and generate statistics on RR interval variations. The following simple measures were considered: mean instantaneous heart rate (HR), mean of RR intervals (MeanRR), and root mean squares of successive differences between adjacent RR intervals (RMSSD). RMSSD is a time

domain parameter, which takes into account only the high frequency (rapid) variation of the RR interval and then specifically quantifies the influence of the parasympathetic branch on heart rate. Its reliability is well recognised in many species including human (Kamen, Krum, & Tonkin, 1996; Sgoifo, De Boer, Buwalda, Korte-Bouws, Tuma, Zaagsma & Koolhaas, 1998 ; Stein, Bosner, Kleiger, & Conger, 1994; Task Force 1996)

The values of the HR, MEANRR and RMSSD which were obtained during the baseline period were subtracted from the values obtained during the presentation of each experimental stimulus. Subsequently, a score of increase/decrease for each indicator was obtained for each ethnic target. Consequently, six new scores were obtained. A positive score indicated an increase and a negative score a decrease of the HR, MEANRR and RMSSD. Because of electrode displacement and electric artifacts, analyses of the cardiac activity of nine participants could not be carried out.

*Electrodermal activity*

Skin potentials were recorded through two adhesive Ag/AgCl electrodes (3M Red Dot , ref. 2248) glued on hypothenar eminence (active site) and on the volar surface of the forearm (reference electrode) of the non dominant hand, following Venables and Christies (1980). Skin potential response (SPR) was evaluated by counting all baseline skin potential modifications, monophasic or biphasic, equal to or greater than 0.2 mV. To estimate electrodermal activity, the number of SPRs produced during the baseline period were subtracted from the number of SPRs exhibited during the presentation of each experimental stimulus. Subsequently, a score of increased/decreased SPR was obtained for each ethnic target. Because of electrode displacement, SPR of one participant could not be computed.

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*Facial EMG*

Surface facial EMG activities were recorded using miniature couples of Ag/AgCl electrodes (10 mm diameter, 20 mm distant) placed over the corrugator supercilii on the right side of the face. To estimate Facial EMG activity, EMG signal's peaks were counted over each experimental period and averaged. This is a relatively easy and useful method to gauge differences in EMG activity (Cacioppo, Tassinary & Fridlund, 1990; Grieve & Cavanaugh, 1973; Willison, 1963). The number of right corrugator supercilii signal's peaks with each ethnic target over a period was computed to establish the mean of EMG signal's peaks within 10 seconds. Two new indicators were obtained. The means of right corrugator signal's peaks within 10 seconds during the baseline period were subtracted from the means of right corrugator signal's peaks within 10 seconds during the presentation of each experimental stimulus. Subsequently, scores of increase/decrease of right corrugator supercilii activity were obtained with each ethnic target. A positive score indicated an increase of the corrugator activity (CA) and a negative score a decrease of the CA. Because of electrode displacement, EMG data of four participants could not be computed.

*Respiratory activity (RA)*

Respiration was monitored with a piezzo electric transducer mounted on a Velcro TM belt (Pneumotrace, UFI, CA). The belt was adjusted and stretched circumferentially at the level of maximal respiratory extension on the chest or the abdomen according to each subject-breathing pattern. To estimate the RA, determination of respiratory rate is one of the more straightforward types of analysis (cf. Lorig & Schwartz, 1990). Reduction of this measurement consists of counting the number of inspiration-expiration cycles over a period and then dividing the data to establish the mean of breaths within 10 seconds. The mean of breaths within 10s during the baseline period was subtracted from the mean of breaths within 10 seconds during the presentation of each experimental stimulus. Subsequently, a score of increase/decrease of the respiratory activity was obtained with each ethnic target. A positive score indicated an increase of the RA, and a negative score a decrease of the RA. Because of displacement of the transducer, RA of one participant could not be computed.

**Self-Reports Measures**

Descriptive statistics are presented in Table 1. For both the Arab and French targets ratings of likeability and cleverness were strongly and positively correlated ($r = .62$, $p < .001$ for the Arab target and $r = .60$, $p < .001$ for the French target). Using both likeability and cleverness ratings, two indicators were computed [3]. First, a relative negative ratings measure was computed by subtracting the Arab target average evaluation from the French target average evaluation. Second, an absolute negative ratings measure was obtained by simply averaging the Arab target ratings. This last score was reverse coded. Consequently, on both measures, higher scores indicated greater negative attitudes toward the Arab target.



## RESULTS

**Table 1.** Emotional intensity effect among respiratory activity, facial EMG and ANS based measures.

| | Emotional intensity effect | | | | |
|---|---|---|---|---|---|
| | Mean (SD) Target ethnicity | | t-test results | | |
| | Arab (outgroup member) | French (ingroup member) | *t* | *df* | *p* < |
| **Self-reports ratings** | | | | | |
| *Likeability* | .44+ (1.56) | .02 (1.72) | 1.38 | 40 | .18 ns |
| *Cleverness* | .68** (1.31) | .36+ (1.39) | 1.45 | 40 | .16 ns |
| **ANS based measures** | | | | | |
| *HR* | -.91 (4.9) | -1.86* (4.2) | 2.56 | 31 | .02 |

| | | | | | |
|---|---|---|---|---|---|
| *MeanRR* | 8.36 (48.8) | 17.9* (40.8) | 2.23 | 31 | .03 |
| *RMSSD* | -2.45 (9.1) | -.35 (10.5) | 2.05 | 31 | .05 |
| *Skin potential response (SPR)* | .76*** (1.4) | .45** (1.0) | 2.31 | 39 | .03 |
| **Facial EMG** | | | | | |
| *Corrugator supercilii* | 1.45*** (1.5) | .59* (1.45) | 4.72 | 36 | .001 |
| **Respiratory Activity (RA)** | | | | | |
| *Inspiration/expiration cycles* | .37*** (.47) | .70*** (.59) | 4.7 | 39 | .001 |

Asterisks indicate a significant difference of the mean from zero
t-test compared the mean between target ethnicity (Arab vs. French)
*Note:* + $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$; HR = mean instantaneous heart rate; MeanRR = mean of RR intervals; RMSSD = root square of the mean of the sum of the squares of differences between adjacent NN intervals.

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## Self-reports ratings

*Relative negative ratings*

The mean score of the relative negative ratings measure ($M$ = -.36) did not differ from 0 ($t$ (40) = 1.6, $p > .11$). Participants evaluated the two ethnic targets in a similar way.

*Absolute negative ratings*

The mean score of the absolute negative ratings measure ($M$ = -.56) differed significantly from 0 ($t$ (40) = 2.8, $p < .008$). This effect tells us that participants expressed a significant positive evaluation of the Arab target.

## Cardiac Activity

*Heart Rate*

As table 1 shows, participants revealed a greater heart rate during the Arab target exposure than during the French target exposure. This effect was not moderated by participant’s negative ratings level.

*Mean RR.*

Participants displayed a lower score of MeanRR during the presentation of the Arab target than during the presentation of the French target (see. Table 1). This effect was not affected by participant's explicit attitudes level.

*RMSSD*

Results reveal a significant effect of target ethnicity [4] (see. Table 1). This effect tells us that participants displayed a lower RMSSD score during the Arab exposure than the French exposure. Participant's ratings were not significantly related to this effect.

**Skin Potential Response (SPR)**

As Table 1 shows, participants revealed a greater level of SPR during the presentation of Arab target than the French target. No other effect was found.

**Corrugator EMG**

As Table 1 shows, participants displayed a significantly greater activity of the right corrugator muscle during the presentation of the Arab target than during the presentation of the French target. However, this effect was significantly affected by participant's relative negative ratings level. As Table 2 shows, the more negatively the participants evaluated the Arab target, the higher was their right corrugator activity during the Arab exposure as compared to the French exposure, $r = .35$, $N = 37$, $p < .03$.

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**Respiratory activity (RA)**

Participants displayed a significantly lower respiratory rate during the Arab target exposure than during the French target exposure (see Table 1). As expected, this effect was affected by participant's negative ratings level (see Table 2). The more participants expressed absolute negative ratings, the lower was their respiratory rate during the Arab target presentation as compared to the French target presentation, $r = -.34$, $N = 40$, $p < .03$.

**Relationships between heart rate, time domains indicators of heart rate variability, skin potential response (SPR), Corrugator EMG and respiratory activity (RA)**

To examine correlations between these different physiological indicators, we first computed several contrasts. More specifically, for each physiological indicator, physiological activity during the presentation of the French target was subtracted from the physiological activity during the presentation of the Arab target. Second, we correlated these different contrasts (see. Table 2). Interestingly, the heart rate target ethnicity effect was negatively correlated with the RMSSD target ethnicity effect ($r = -.54$, $p < .002$). The RMSSD target ethnicity effect was also positively correlated with the meanRR target ethnicity effect ($r = .54$, $p < .002$). SPR, RA and Facial EMG were not correlated with any other physiological index.

**Table 2.** Correlations among psychophysiological indicators and self-reports ratings.

| | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|
| C1- HR | - | | | | | | |
| C2- MeanRR | .94*** | - | | | | | |
| C3- RMSSD | -.54** | .54** | - | | | | |
| C4- SPR | .05 | -.05 | .06 | - | | | |
| C5- Right Corrugator EMG | .06 | .08 | .15 | -.23 | - | | |
| C6- RA | .19 | -.08 | -.03 | .06 | .18 | - | |
| C7- Absolute negative ratings | -.04 | .0 | .19 | .05 | .16 | -.34* | - |
| C8- Relative negative ratings | .17 | -.09 | .06 | -.05 | .35* | .10 | .49*** |

*Note*: * $p < .05$; ** $p < .01$; *** $p < .001$; ; HR = mean instantaneous heart rate; MeanRR = mean of RR intervals; RMSSD = root mean squares of successive differences between adjacent RR intervals; SPR = Skin Potential Response; RA = Respiratory Activity.

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**Ancillaries analyses**

In order to examine if, during the Arab target exposure compared to the French, decrease in parasympathetic activity was a source of heart rate acceleration and of meanRR reduction, ancillaries' analyses were computed. As predicted, the heart rate target ethnicity effect is no longer significant when the RMSSD target ethnicity effect is the covariate in an ANCOVA, $F$ (1, 29) = 2.66, $p > .115$, whereas it is significant without the covariate $F$ (1, 31) = 6.55, $p < .02$. Similarly, the meanRR target ethnicity effect disappears when the RMSSD target ethnicity effect is the covariate in an ANCOVA, $F$ (1, 29) = 1.56, $p > .22$, whereas it is significant without the covariate $F$ (1, 31) = 4.95, $p < .03$.

**Factor Analyses**

In order to clarify the relationships among the various measures of prejudice used in this study, a factor analysis was conducted. Because heart rate is largely redundant with meanRR, it was excluded from the factor analysis. Principal factors extraction with a varimax rotation was performed. As Table 3 shows, four factors explaining 85.3 % of the variance emerged. MeanRR and RMSSD target ethnicity effects load highly on the first factor. Both the relative and the absolute negative ratings measures represent the second factor. The third factor is defined by both the respiratory activity and the right Corrugator EMG target ethnicity effects. The fourth factor is represented by a single variable, the SPR target ethnicity effect.

**Table 3.** Factor loadings after varimax rotation in the factor analyses.

| | Factor 1 | Factor 2 | Factor 3 | Factor 4 | |
|---|---|---|---|---|---|
| RMSSD | .90 | - | - | - | |
| MeanRR | .87 | - | - | - | |
| Relative negative ratings | - | .93 | - | - | |
| Absolute negative ratings | - | .73 | - | - | |
| RA | - | - | .91 | - | |
| Right Corrugator EMG | - | - | .55 | - | |
| SPR | - | - | - | .94 | |
| *Percent of Variance* | 23.4 | 23.3 | 21.3 | 17.3 | 85.3 |

All factor loadings below .50 have been deleted.
*Note* : RMSSD = root mean squares of successive differences between adjacent RR intervals; HR = mean instantaneous heart rate; RA = Respiratory Activity; SPR = Skin Potential Response.



**DISCUSSION**

In this study, and consistent with previous research demonstrating the limits of self-report, physiological responses of participants revealed bias against Arabs, but overall self-report measures failed to do so (see also Vanman & al., 1997). On the self-report measures, participants report neutral attitudes toward both the French and Arabic target. In that sense, psychophysiological methods seem valuable to assess the multifaceted nature of prejudice.

As expected, ANS activity based measures appear to be a better indicator of emotional arousal than of affective valence. While ANS physiological responses, through 4 indicators, were significantly affected by the ethnicity of the target, the prejudice level of participants affected none. In other words, ANS activity based measures can be seen as an indicator of intergroup anxiety or threat. For example, Stephan & Stephan (1985) argued that intergroup anxiety can be defined as a type of stress that is accompanied by heightened ANS activity. While this effect is not significantly related to participant's explicit attitudes in the present study, it has been demonstrated that social factors like intergroup contact can moderate cardiovascular reactivity. More specifically, Blascovich et al. (2001, study 3) reveal that those who reported more contact with outgroup members exhibited less physiological threat when interacting with them. In other words, it seems that a high level of intergroup anxiety is not necessarily related to a high level of prejudice, suggesting that both reflect relatively independent psychological processes.

Interestingly, the results also reveal that the Arab target presentation, when compared to the French, leads to a significant decrease in parasympathetic activity, and this decrease produces a significant heart rate acceleration. Such findings do not negate the influence of the cardiac sympathetic activity but suggest that the cardiac *parasympathetic* division of the ANS need to be

considered to understand the expression and regulation of emotions like prejudice (Bradley, 2000; Quigley & al., 1990; Porges, 1991, 1995).

Concerning corrugator EMG, the results of Vanman et al. (1997; study 3) were replicated in the French intergroup context. Apparently, what is true in the intergroup context between African Americans and White Americans in United States can also be true in a different intergroup context such as Arab/French relations in France. The fact that these results were replicated using a different methodological procedure (i.e. experimental manipulation and data reduction) supports the validity of our procedure. Moreover, it suggests that facial EMG is a valid indicator of both emotional intensity and evaluative direction of ethnic-related stimuli, enabling one to index affective reactions to negative stimuli (Bradley & al., 1996; Fridlund & Izard, 1983; Greenwald & al., 1989; Vrana, 1993). In addition, in this study, respiratory activity appears as a new indicator of involuntary affective processes underlying prejudice. Confirming the study of Boiten (1998), results revealed that RA is not only affected by valence and intensity of emotion, but it is also clearly sensitive to the arousal and direction of the evaluation of ethnic-related stimuli (i.e. participant's prejudice level).

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Generally consistent with our interpretation, a factor analysis yielded a four factor solution, with the two cardiac activity indicators representing the first factor, the two explicit self-report measures loading highly on the second factor, the facial EMG and RA representing the third factor, and the electrodermal activity constituting the fourth factor. We suggest that the first factor describes the cardiac ANS activity that is mainly sensitive to emotional intensity. While it seems clear that the second factor constitutes the explicit, controlled component of prejudice, we suggest that the third factor represents the physiological indicators that are sensitive to both the intensity and affective direction of ethnic-related stimuli. Finally, contrary to our prediction, electrodermal activity seems to be distinct from other ANS activity based measures. However, this result tells us that the impact of target ethnicity on both cardiac and electrodermal activities occurs by using distinct physiological processes. Whereas SPR is an indicator of sympathetic activity, results tend to show that cardiac activity indicators used in this study are more related to the parasympathetic division of ANS. In that sense, it is possible that the distinction between the first and the fourth factor illustrate the autonomic differentiation of emotion between the sympathetic and the parasympathetic divisions of the ANS (Berntson, Cacioppo & Quigley, 1991, 1993; Hugdahl, 1996). The absence of correlation between SPR and the cardiovascular responses is consistent with this interpretation.

Overall, these results confirm the distinction proposed within the model of Guglielmi between the implicit and the explicit affective components of prejudice (see Guglielmi, 1999, "Tricomponent, bilevel, multimethod model for the assessment of intergroup attitudes"). But, regarding prejudice, data in the present study also suggest an important distinction between physiological indicators assessing the involuntary arousal processes underlying prejudice (ANS activity based measures) and those assessing both the involuntary arousal and affective valence processes underlying prejudice (facial EMG and RA).

There are some limitations in this study that should be addressed in the future. For practical reasons, we always presented the ingroup target first, and the outgroup target second. We did this so as to eliminate a habituation effect. Psychophysiological responses tend to decrease with time (habituation). This means that over time we would expect that heart rate, EMG activity, skin potential responses and respiratory activity would decrease more during exposure to the Arab target since this was always presented second. With the exception of respiratory activity (which needs to be interpreted with caution), the results were exactly the opposite. Thus it cannot be said that habituation affected the outcomes of this study. Nonetheless, these results should be replicated using a random design that control for habituation. Additionally, an experimental paradigm using interactions with real outgroup members, as opposed to computer representations, and a more sophisticated explicit measure of prejudice would add considerably to the validity of these results.

Given the relative paucity of research on the psychophysiological bases of prejudice, the data presented in this study clearly support the need for further research in this area. Not only have we replicated previous findings, something that is of vital importance in a newly emerging field of inquiry, but we have also documented the role of some new psychophysiological indicators that are relatively independent of self-reports measures. This means that assessing prejudice with traditional questionnaire measures reveal only one dimension of the multifaceted nature of prejudice. Only by gathering more information on other dimensions can we progress toward a better and more complete understanding of the complex human reactions to ingroup and outgroup members.



**ENDNOTES**

[1] The autonomic nervous system regulates the internal environment of our body and provides the appropriate internal state to meet shifts in both internal and external demands. It is composed of two subsystems: the sympathetic and parasympathetic nervous systems. These subsystems represent neural control systems that originate in the brain and contribute to the regulation of a variety of target organs and viscera. Most of our organs are innervated by both the sympathetic and parasympathetic nervous systems (e.g. heart). Others, such as sweat glands, are solely innervated by the sympathetic nervous system. The study of heart activity (with electrocardiogram) open a window on sympathetic and parasympathetic influences on this organ, while the study of sweating activity (electrodermal activity) inform on sympathetic activity solely.

[2] Portrait of each target was presented during a brief delay (150 ms) in the center of the screen in order to insure that race would be the main information perceived by participants. This procedure had been pre-tested on 5 participants. After exposure to the two target ethnic portraits, they were asked to recall all the elements that they had seen during exposure. The only information that the participants recalled about the portraits was that one target stimulus was a French male and the other an Arab male. Portraits used in this experiment were adapted from those used by Dovidio, Kawakami, Johnson, Johnson, & Howard (1997). These two portraits

were comparable in perceived attractiveness, intelligence, friendliness, and likeability (see. Dovidio & al., 1997).

[3] In a pre-test done with 120 psychology students, we validated our self-report measures of prejudice by examining their relationships with two valid measures: the generalized prejudice scale towards Arabs and an ingroup bias measures against Arabs ( Dambrun & Guimond, 2001; Guimond & Dambrun, 2002; Guimond, Dambrun, Duarte & Michiniv, in press). Using likeability and cleaverness ratings of Arabs, two indicators were computed: the relative negative ratings and the absolute negative ratings. The results revealed that both indicators were strongly related in the expected direction to the generalized prejudice scale and to the ingroup bias measure. More specifically, the relative negative ratings and the absolute negative ratings were significantly and positively related to the scale of generalized prejudice toward Arabs (respectively, $r = .38$, $p < .001$and $r = .32$, $p < .001$) and to the measure of ingroup bias against Arabs (respectively, $r = .40$, $p < .001$ and $r = .33$, $p < .001$).

[4] Analysis of covariance testing the target ethnicity effect on RMSSD scores, with respiratory activity as covariate, revealed the same basic effect reported in Table 1. According to Berntson et al. (1997), because this RMSSD target ethnicity effect is not affected by respiratory activity, it can be interpreted as a pure parasympathetic effect.

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## AUTHORS' BIOGRAPHIES

Michaël Dambrun is currently a research associate at McGill University, Canada. His main research interests are stereotyping, prejudice and intergroup relations. Email address: dambrun@srvpsy.univ-bpclermont.fr

Gérard Desprès is a professor of Neuroscience at the Université Blaise Pascal of Clermont-Ferrand, France. His main research interest is the psychophysiology of emotion. Email address: despres@srvpsy.univ-bpclermont.fr

Serge Guimond is a professor of social psychology at the Université Blaise Pascal of Clermont-Ferrand, France. His main research interests are intergroup relations and group socialization. Email address: guimond@srvpsy.univ-bpclermont.fr

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