Rear Negativity:
Verbal Messages Coming from Behind are Perceived as More Negative

Natalia Frankowska^{*ab}

Michał Parzuchowski^b

Bogdan Wojciszke^b

Michał Olszanowski^a

Piotr Winkielman^{ac}

^aSWPS University of Social Sciences and Humanities, Warsaw Faculty, Warsaw, Poland

^bCenter of Research on Cognition and Behavior, SWPS University of Social Sciences and
Humanities, Sopot, Poland

^cUCSD, La Jolla, USA

^{*}Correspondence concerning this article should be addressed to Natalia Frankowska, ul.
Chodakowska 19/31, 03-815 Warsaw, Poland. Email: nfrankowska@swps.edu.pl

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Highlights

- We examine whether spatial location influences the interpretation of an ambiguous auditory message.
- We test the effect using social stimuli and various manipulations of personal relevance of the message.
- Spatial location behind the listener lowers evaluation, especially for self-relevant messages.

This highlights the tight interface between attentional, evaluative, and social processes.

Abstract

Many studies have explored the evaluative effects of vertical (up/down) or horizontal (left/right) spatial locations. However, little is known about the role of information that comes from the front and back. Based on multiple theoretical considerations, we propose that spatial location of sounds is a cue for message valence, such that a message coming from behind is interpreted as more negative than a message presented in front of a listener. Here we show across a variety of manipulations and dependent measures that this effect occurs in the domain of social information. Our data are most compatible with theoretical accounts which propose that social information presented from behind is associated with uncertainty and lack of control, which is amplified in conditions of self-relevance.

Keywords: rear negativity, sound, spatial location, alarm theory,

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*The most disagreeable thing that your worst enemy says to your face
does not approach what your best friends say behind your back.*

Alfred de Musset

People receive a lot of information about the environment through their auditory system (Asutay & Västfjäll, 2015). While it is possible to cut off oneself from visual stimuli (by closing one's eyes), it is almost impossible to completely block out incoming auditory stimuli. Sounds carry key information about surroundings. In the physical domain, what people hear often prepares them for, and helps them interpret what they will see (Horowitz, 2013). In the social domain, the spoken word is a major tool of communication (Chomsky, 1966/2009; Scott-Phillips, 2015). Therefore, interpreting spoken messages is an essential part of interactions with other people (Heald, Hedger, & Nusbaum, 2016). The content of the message is the most important part of its interpretation, but it is not the only one. Because people keep changing their relative spatial position to others, social auditory signals reach us from various locations. Some messages come from the front. This occurs during face-to-face interactions, which allow listeners to follow speakers' eyes, facial expressions and gestures, providing valuable information about their motivations, intentions, and traits (Argyle, & Dean, 1965; Thayer, & Schiff, 1974; Kleinke, 1986). However, sometimes people do not face the speaker. This occurs when they need to watch what is in front of them and/or are unable to turn around. For example, a driver may hear a passenger's request while needing to watch the road. A student, a conference participant, or a roommate may hear a question or a comment from behind, while facing a teacher, a speaker, or a TV screen. A responder in an emergency vehicle, a mountain climber walking in single file, a member of a kayak crew, or a soldier in a battle, all may hear an important communication from the back. Relatedly, for people with a disability it might not even be an option to turn towards the incoming sound

each time they are being addressed from behind. In short, many social situations involve an arrangement where the listener receives auditory messages from various spatial locations. In the present article, we explore evaluative consequences of auditory social stimuli presented from behind.

We hypothesize that spatial location of a source serves as a cue to the perceived valence of verbal information. More specifically, we propose a *rear negativity effect* such that verbal messages coming from behind a listener are perceived as more negative than identical messages coming from in front of the listener. We present a series of studies demonstrating this basic effect as well as showing that the effect is increased (or only occurs) for information that is personally relevant to the listener. Before we describe the studies, we offer some background on research and theorizing related to the impact of spatial location on descriptive and evaluative meaning of visual and auditory stimuli.

Spatial Location and Valence

There is much evidence that spatial location influences descriptive associations. For example, small numbers are associated with the left position and large numbers with the right position – an effect known as spatial-numerical association of response codes, SNARC (Dehaene, Bossini, & Giraux, 1993; Riello & Rusconi, 2011). In the domain of abstract concepts, a well-known example is the association of the future and the past with forward or backward motion (Boroditsky, 2000).

More relevant to our focus here, spatial location is also associated with valence. The inspiration for much of the empirical work on this relation comes from Lakoff and Johnson's (1980) proposal that concrete (experiential) concepts, such as spatial locations (left/right, up/down, front/back) help represent some abstract (metaphorical) concepts. One illustration in the social domain are demonstrations of an association between high vertical position and positivity (Barsalou, 2008; Slepian, Ambady, & Mesicampo, 2015). For example, Meier and

Robinson (2004; 2006) found that positive words were evaluated quicker when presented in the upper part of the screen, whereas negative words were evaluated quicker when flashed in the lower part of the screen (Meier & Robinson, 2004). Similarly, participants judged groups to possess more power when the groups' names appeared in upper parts of the screen (Schubert, 2005).

The horizontal dimension (left/right) is also associated with evaluative meaning (e.g., Natale, Gur, & Gur, 1983; Davidson, 1992). For example, Casasanto (2009) showed that mappings of spatial location to emotional valence differs between right and left-handed participants - right-handers tended to associate rightward space with positive ideas and leftward space with negative ideas, while it was reversed for left-handers. In sum, changing the vertical and horizontal location of stimuli alters the interpretation of their emotional meaning.

The above effects were found for visual processing, but what about sound? In the domain of acoustic stimuli, there is also some evidence of spatial location influencing evaluation. Indeed, researchers have theorized that people react with stronger affective response if the sounds are emitted very close to their body (Graziano & Cooke, 2006; Hsee, Tu, Lu & Ruan, 2014; Maier & Ghazanfar, 2007). Consistently, Västfjäll (2003) found that emotional reactions increase with improved auditory spatial resolution in virtual environments. Based on this, some propose that the auditory system serves as an alarm system or an 'importance detector' (Juslin & Västfjäll, 2008). Consistent the "alarm system" idea, recent studies have shown an auditory bias for a specific sound location - faster detection of sounds occurring behind listeners and stronger emotions in response to such sounds (Asutay & Västfjäll, 2015). These results showed that both localization speed and accuracy were higher, and that stronger negative emotions were induced when sources of sound were localized behind the participants (than in front). This is consistent with other

research showing the influence of sound location, distance, or room size on auditory-induced emotion (e.g. Tajadura-Jiménez, Larsson, Väljamäe, Västfjäll, & Kleiner 2010b).

While there is much work on non-social sounds, research on emotional responses to verbal social information coming from different locations is in its infancy. Previous studies focused solely on ecological sounds and largely ignored the social meaning (i.e., content) of presented sounds. One exception is work suggesting that taboo words induce attentional biases towards their spatial location, but even this work did not address higher-level variables such as message evaluation (Bertels, Kolinsky, and Morais, 2010; Goldring, Dorris, Corneil, Ballantyne, & Munoz, 1996).

To our knowledge, no research has experimentally manipulated the spatial location of spoken messages to assess its influence on evaluation and explore the underlying mechanisms. This is crucial because, as discussed earlier, audition provides information about socially important events that are happening outside the visual field. In particular, there have been no empirical tests of the front/back location. In the present article, we investigate the possibility that verbal information presented behind a listener is construed more negatively than same message in front of the listener. Furthermore, we test whether this effect is moderated by personal relevance of such information for the listener. In the next section, we briefly explain some possible reasons for an association between rear location and negative valence of social information, with more theoretical elaboration offered in the discussion section.

Appraisal as a Complex Alarm System

Before we consider more complex factors, it is worth noting that emotional significance of objects provides cues for allocation of attentional resources needed to cope with them (Armony & LeDoux, 2010; Lang & Bradley, 2010). LeDoux (2012), for example, proposes that danger cues can quickly activate “survival circuits”, mobilizing early perceptual

and attentional processes. Indeed, studies show that negative emotional meaning of tones (learned via aversive conditioning) influences early auditory processing and engages auditory attention (Bröckelmann et al., 2011).

Social messages are clearly processed by more complex interpretative mechanisms. According to appraisal models, evaluative reactions are formed via an interpretation of events by the individual (Arnold, 1960; Lazarus, 1991; Frijda, 1986; Scherer, 2009a; 2009b). Lazarus (1991) suggests that the strength and nature of evaluative reactions depend on assessment of the relevance of an object to the individual. Similarly, the Component Process Model proposed by Scherer (2009a, 2009b) suggests that an event and its consequences are first appraised according to a set of criteria such as relevance, significance, and coping potential, and only then does the event lead to an emotional episode. Based on these theories, we assume that checking whether a detected sound is relevant to a listener is a key step in its appraisal. Relevant information would then be more engaging and processed with increased attention.

Critically, we propose that the spatial location of a message source serves as a cue to message valence and that sounds located behind a listener are more likely to elicit a negative evaluation. This proposal reflects multiple considerations and can be derived from several theories. In the discussion section, we will elaborate how our data fit appraisal theories, metaphor theories, fluency theories, uncertainty theories, affordance theories, and associative-learning theories. For now, the key considerations come from appraisal theories of emotion. Specifically, the negative construal of rear location derives from its current or past association with perceived lack of control. Moreover, we propose that this association of negative valence with rear location is moderated by personal relevance of its content. This proposal is based on the assumption that an early step of every appraisal process involves checking whether a stimulus is relevant. Relevance shifts attention to the stimulus and only

after confirmation, the next steps of appraisal are engaged. Thus, besides the spatial location of a message source, the mere knowledge that the stimulus is personally relevant influences processing of its valence. Therefore, we expect the effects of spatial location to be stronger or emerge only for personally relevant messages. We highlighted previously that auditory messages from various directions are the major tool of communication between people. Therefore, we assume that interpretational biases for the sounds are inherently social. Below we show across a variety of manipulations and dependent measures that the rear negativity effect is present in the domain of social information.

Present Studies

In Study 1, we tested the hypothesis that listeners perceive verbal messages coming from behind as more negative than the same messages coming from the front. We manipulated sound location while playing neutral stimuli (a set of Chinese sentences nonsensical to our participants who had no knowledge of Chinese). Participants' task was to guess the stimuli valence based only on prosody. In Study 2, we tested the same hypothesis but with meaningful verbal messages. We manipulated sound location when playing pre-recorded verbal feedback on a participant's purportedly average performance in a bogus intelligence test taken immediately before. In Study 3, we tested an additional aspect of our hypothesis that listener perceive verbal messages coming from behind as especially negative when such messages are more relevant. We manipulated the sound location of a Chinese message ostensibly referring to Polish (in-group) or Chinese (out-group) students. In Study 4, we tested the hypothesis that a negative verbal message is recognized more quickly when presented from behind and even more quickly when relevant to the listener. We manipulated the sound location of a list of positive/negative traits about in-groups and out-groups. In all studies, we examined whether the spatial location affected perceptions of the evaluative

meaning of the verbal messages. In line with current best practices, we report all measures (but we present some of them in the supporting materials), conditions, and exclusions.

Study 1

In Studies 1 and 2 we aimed to demonstrate *rear negativity* – the basic effect tested in the present research. We expected that listeners perceive verbal messages coming from behind as more negative than the same messages coming from the front. Study 1 tested this hypothesis for the perception of valence of messages in a language (Chinese) incomprehensible to our participants. Study 2 tested this hypothesis for the perception of verbal feedback conveyed in the native language of participants (Polish). In both studies the spatial location of the source of messages (behind vs. in front of listeners) was manipulated.

Method

Participants and design. There were 42 participants (21 female), with a mean age of $M = 22.10$; $SD = 2.88$, randomly assigned to one of two verbal information presentation conditions between subjects: *in front* or *from behind*. A power analysis, using the G*Power 3.1.9.2 software (Faul, Erdfelder, Lang, & Buchner, 2007), indicated that such sample size would provide power $1 - \beta > .80$ in case of effect size $d > .90$. Verbal sentences were played from one of two speakers using the setting developed in the pilot study. None of the participants declared the ability to speak or understand Chinese.

Procedure. Participants completed the task one at a time. They were given written introductions to the study, including information that the experimenter would cover the participant's eyes and they would train their ability to recognize valence based on prosody of nonsensical sentences. Next, the blindfolded participants orally assessed the valence of each of 22 sentences spoken in Chinese on a 5-point scale (from 1 – *the sentence is negative* to 5 – *the sentence is positive*). In the behind condition participants heard these sentences voiced

from a speaker located behind them, and in the in front condition they heard the same messages voiced in front.

The sentences were spoken by a Chinese native speaker and included practical, everyday phrases (e.g., „May I have a small, black coffee?“, „How much is that dress?“, „How do I get to the train station?“, „No, thank you, I’m not hungry.“). Additionally, we controlled for motivation for rating the sentences using two questions: „I did not pay attention to the sentences I categorized“ and „I rated most of sentences randomly“ on a 5-point scale (from 1 – *strongly disagree* to 5 – *strongly agree*).

Spoken messages were presented through loudspeakers, one located directly in front of the participant and one located to the rear of the participant. Each loudspeaker was placed on top of a desk at a height of 75 cm, and at a distance of 1.50 m from the participant (see Figure 1A). Sentences were played on the 65 dB level that corresponds to normal level of daily speech (Gils, 1962; Van Engen, Phelps, Smiljanic, & Chandrasekaran, 2014). These settings were also applied in all subsequent studies.

Figure 1. (A) Design of all studies. Two loudspeakers were located 1.5 m from the participant. One of the loudspeakers was located directly in front of the listener while the other one was in the back. (B) Timeline of the session in Study 4. Participants indicated the trait valence as quickly and accurately as possible during the sound presentation.

Results and Discussion

As predicted, participants in the rear condition rated valence of sentences as more negative ($M = 2.84$, $SD = .22$) than those in the front condition ($M = 3.26$, $SD = .34$), $t(41) = 4.71$; $p < .001$; $d = 1.46$, $CI [.24, .59]$. There was no difference in the level of self-rated motivation to answer the questions between the two conditions (in front $M = 2.93$, $SD = .86$; in the rear $M = 2.88$, $SD = 1.08$), $t(41) = .16$; $p = .89$; $d = .05$, $CI [-.56, .65]$.

Results of Study 1 supported the rear negativity hypothesis about the relation between the spatial location of a message source and assessments of the message valence. The nonsensical messages coming from behind were perceived as more negative than the same messages presented from the front. Because the whole task was presented as a measurement of the participants' ability to infer evaluative meaning from speech prosody, the task may be regarded as at least modestly self-relevant. Importantly, the effects cannot be explained by visual differences as participants were blindfolded.

Study 2

This study investigated the rear negativity effect again, but this time with meaningful stimuli involving information of high relevance to our participants. To better engage participants in what they heard, we used understandable (and evaluatively neutral) feedback about their performance on a bogus Social Intelligence Test. To this end, we presented the feedback information either from behind or in front of the participant and then measured perceptions of its valence. Additionally, we measured the valence and intensity of participants' affective states both before and after the feedback information to assess possible affective changes introduced by this information at its spatial location.

Method

Participants and design. Based on the previous experiment and achieved power we tested 38 participants (23 female) with a mean age of $M = 21.87$; $SD = 1.71$, according to power analysis with G*Power 3.1.9.2 (Faul et al., 2007) indicated that such sample size would provide power $1 - \beta > .80$ in case of effect size $d > .95$. We informed participants that the study tested their abilities as measured by the Social Intelligence Test. After solving the test, participants received bogus feedback on their performance always presented as average. We manipulated the spatial location of the feedback message, which was played in front of participants or behind their backs, with between subjects design.

Procedure. Participants were tested individually. First, they completed an Emotions Grid (Russell, Weis, & Mendelsohn, 1989) assessing their current emotions on a two-dimensional grid where the vertical axis representing pleasant feelings and the horizontal representing arousal. Next, they were presented with the ostensibly primary task, the Social Intelligence Test, which was supposedly still under construction. The test consisted of briefly presented black and white photographs of 50 infants on a computer screen, with the instruction to identify the gender of each infant. Participants were told that a person's ability to recognize infant traits, such as gender, was a potent sign of social intelligence. When the test ended, the program generated a fictional result, that is, neutral feedback prepared earlier using a speech synthesizer and pre-tested for clarity and valence. The front/back location of the feedback source was manipulated between subjects. All participants heard the same information estimating their social intelligence as average.

After receiving the feedback, participants were asked to rate their satisfaction with the test results by responding to 6 statements (Cronbach's $\alpha = .65$; e.g., "I believe I did well on the Social Intelligence Test") on a 5-point scale from 1 – *strongly disagree* to 5 – *strongly agree*. We then informed participants that the test was still at initial phases of its construction

and asked them to estimate the test validity by answering 9 statements (Cronbach's $\alpha = .84$; e.g., "I believe the test is well constructed") on a 5-point scale from 1 – *strongly disagree* to 5 – *strongly agree*. We also measured their self-esteem using Rosenberg's SES (1965) on a 7-point scale, from 1 – *strongly disagree* to 7 – *strongly agree*, adapted to Polish by Łaguna, Lachowicz-Tabaczek, & Dzwonkowska (2007). Next, we repeated the pleasure and arousal rating on the Emotions Grid (Russell et al., 1989) and asked for demographic data (i.e., age and gender). Finally, participants answered questions checking the efficiency of manipulation ("From which direction did the feedback come?" and "What was the gender of the person reading out your feedback?").

Results and Discussion

Initial analyses. Analyses of the manipulation check questions showed participants correctly indicated the messages' location and the gender of speakers regardless of the experimental condition. The χ^2 - Pearson test revealed that the correctness of the answer to the questions from which direction the information was coming and what was the gender of the speaker was independent of the location of the information source, respectively: $\chi^2 = .19$; $p = .67$ and $\chi^2 = .97$; $p = .32$.

A 2 (location: in front vs. in the rear) x 2 (measurement time: pre-test vs. post-test) mixed ANOVA on self-reports of pleasant feelings did not reveal any significant effect. Both main effects of location, $F(1, 36) = 1.90$, $p = .176$, $\eta_p^2 = .05$, in front ($M = 6.92$, $SD = 1.32$) vs. behind ($M = 6.28$, $SD = 1.53$), and measurement time, $F(1, 36) = .01$, $p = .949$, $\eta_p^2 = .000$, pre-test ($M = 6.58$, $SD = 1.52$) vs. post-test ($M = 6.58$, $SD = 1.67$), as well as their interaction, $F(1, 36) = 1.50$, $p = .229$, $\eta_p^2 = .04$, failed to reach significance. A similar ANOVA on arousal did not reveal significant main effects of information location, $F(1, 36) = .44$, $p = .512$, $\eta_p^2 = .02$, in front ($M = 5.58$, $SD = 1.71$) vs. behind ($M = 5.23$, $SD = 1.63$); the measurement time, $F(1, 36) = 1.45$, $p = .236$, $\eta_p^2 = .039$, pre-test ($M = 5.24$, $SD = 1.85$) vs.

post-test ($M = 5.55$, $SD = 1.83$), nor their interaction, $F(1, 36) = .07$, $p = .795$, $\eta_p^2 = .002$.

These analyses indicate that sound location did not influence self-reported feelings.

Main analyses. As predicted by the rear negativity hypothesis, participants in the rear condition were less satisfied with their results ($M = 2.99$) than those in the front condition ($M = 3.31$) and this effect was medium in size, as can be seen in Table 1. In addition, subjective estimates of the quality Social Intelligence Test validity showed the same pattern. Participants in the back condition rated the test as a worse measuring tool ($M = 3.92$) than those in the front condition ($M = 4.53$). Finally, participants in the rear condition reported lower self-esteem ($M = 4.99$) than those in the front condition ($M = 5.45$).

Table 1. *Descriptive statistics, independent sample t-test results as a function of condition, effect sizes and 95% CIs for variables measured in Study 2*

	front condition $n = 19$ $M (SD)$	rear condition $n = 19$ $M (SD)$	t	d	CI
Satisfaction with the test results	3.31 (.58)	2.99 (.52)	1.76*	.58	(-.68, .05)
Test validity	4.53 (1.05)	3.92 (.69)	2.18*	.70	(-1.20, -.04)
Self-esteem	5.45 (.55)	4.99 (.83)	1.97*	.65	(-.92, .01)

Note: Next to the variable name in the first column in parentheses the answer scales are given. For t -tests one-tailed tests were used. Within each row, means with different subscripts are significantly different, *** $p < .001$, ** $p < .01$, * $p < .05$.

Results of Study 2 supported the hypothesis that the location of an information source influences evaluation of information that is meaningful and relevant for a listener. We found

that the information located behind the listener lowered reported satisfaction with the results, perceived test quality, and self-esteem. The broad nature of the effect suggests that the rear location causes a general negativity in evaluations. It should be noted however, that the observed effect size was smaller than the one we observed in Study 1 and used in the power analysis of Study 2 ($d > .95$ expected vs. $d > .58$ observed in Study 2). Even though we managed to replicate the rear negativity effect, for now the current results should be interpreted with some caution. Interestingly, these decreases on measures of evaluative judgments were not accompanied by decreases on direct measures of self-reported feelings of pleasure or arousal. This suggests that the rear negativity effect is not simply due to a decrease in global affective states. However, it is worth noting that the self-reported feelings were assessed with a tool designed to measure strong affective states (Russell et al., 1989). The feelings were also measured after the participant filled out all the other evaluative measures. According to the affect judgment model (Schwarz & Strack, 1999), this may have caused any affective changes to be absorbed in earlier evaluative ratings (or the affect simply dissipated).

Study 3

Studies 1 and 2 showed rear negativity in evaluations of personally relevant messages. However, personal relevance was kept high, rather than manipulated. We introduced such a manipulation in the present study. To this end, we used the incomprehensible stimuli from Study 1, but this time we presented them as messages expressing evaluations of in-groups (the high-relevance condition) or out-groups (the low relevance condition). We informed our participants that the study concerned their ability to recognize valence through prosody. We asked them to listen to opinions of a Chinese student who was supposedly taking part in a year-long exchange program in Poland. Based on social identity theory (Tajfel & Turner, 1986) and the well-known effects of group belongingness

on evaluations and self-evaluations (Brewer & Weber, 1994; Tesser, 1986; 1988), we introduced the message voiced by the Chinese student as concerning his opinion about Polish students (the high self-relevance condition) or as his opinion about Chinese students (the low self-relevance condition).

Method

Participants and design. We tested 131 participants (52 females, age: $M = 22.10$; $SD = 2.88$). Participants were randomly assigned to a condition in a 2 (source of message location: in front vs. to the rear) 2 (self-relevance: high vs. low) design, with both factors manipulated between participants. Due to the diminishing effect size between Study 1 and Study 2, a power analysis, performed with G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007), indicated that our sample size would be sufficient to detect an effect at a size of $f > .25$ with power $1 - \beta > .8$. The cover story and information location manipulation were the same as in Study 1.

Procedure. The respondents took part in research individually. Under the guise of studying the ability to recognize valence through prosody, participants listened to 22 sentences spoken in Chinese. The cover story presented the statements as uttered by a Chinese student who spent a one-year scholarship in Poland. Depending on the condition, the participants were informed that the opinions concerned a group of Polish students (high-relevance condition) or a group of other Chinese students (low-relevance condition) and the opinions were played from a loudspeaker located either in front or behind the participants. After each opinion, participants reported their estimate of its perceived valence on a 5-point scale (as in the Study 1). These estimates were averaged to a global index of valence (Cronbach's $\alpha = .73$). Additionally, the students were asked to rate their general perception of the Chinese student's opinion by commenting on the following statement: "In my reading, the Chinese student's opinion about other Chinese/Polish students is": 1 = *strongly negative*, 5 =

strongly positive. In this study we also measured positive and negative personality traits that other Chinese/Polish students possess in the opinion of the Chinese student (the reader).

Analysis of these variables are presented in the supporting material (S1).

Results and Discussion

We predicted that participants in the rear condition would rate both average valence of individual statements and general perception of spoken information as more negative than participants in the front condition. Moreover, we predicted that participants in the *back/self-relevant condition* would rate both valence and general perception of spoken information as more negative than participants in the other three conditions.

Consistent with expectations, a 2 (location: front vs. back) $\times$ 2 (relevance: high vs. low) analysis of variance on valence ratings revealed a significant main effect of the information source location, $F(1, 127) = 72.42, p < .001, \eta_p^2 = .36$, revealing that participants in the rear condition perceived the valence of spoken information as more negative ($M = 2.84; SD = .78$) than participants in the front condition ($M = 3.32; SD = .75$). The main effect of relevance condition was not significant, $F(1, 127) = 1.63, p = .204, \eta_p^2 = .013$. The interaction between the location and relevance was significant, $F(1, 127) = 5.39, p = .022, \eta_p^2 = .04$. Participants in the rear condition rated valence as more negative when the information was presented as highly relevant ($M = 2.71; SD = .83$) than low in relevance ($M = 2.92; SD = .76$) as illustrated in Figure 2.

We used a planned-comparison strategy to test the hypothesized differences (Scheffé, 2012). As predicted, paired comparisons showed that participants in the rear/high-relevant condition ($M = 2.71, SD = .33$) rated the valence of spoken information as more negative than participants in the rear/low relevant condition ($M = 2.92, SD = .31$), $p < .01$. Participants in the rear/high relevant condition rated the sentences' valence as more negative ($M = 2.71, SD = .33$) than participants in the front/high relevant condition ($M = 3.35, SD = .32$), $p < .001$.

Conversely, participants in the rear/low relevant condition rated information valence as less negative ($M = 2.92$, $SD = .31$) than participants in the front/low relevant condition ($M = 3.29$, $SD = .38$), $p < .001$. Finally, there were no differences in valence ratings between the front/high relevant ($M = 3.35$, $SD = .32$) and the front/low relevant condition ($M = 3.29$, $SD = .38$), $p = .471$. These results suggest that the rear location causes perceptions of negative valence regardless of the information's self-relevance, and that high self-relevance enhances this negativity. In other words, the rear negativity effect emerges in both low and high personal relevance of the perceived information, though it is more pronounced in the high relevance condition.

Figure 2. Mean ratings of the spoken information valence as a function of the location of its source and relevance. Error bars represent standard errors (Study 3).

A similar 2 (front vs. back) 2 (low vs. high relevance) analysis of variance was performed on the single-item rating of the Chinese student's general opinion. This analysis revealed a marginally significant main effect of the information location, $F(1, 127) = 3.06$, $p = .083$, $\eta_p^2 = .024$, indicating that participants in the rear condition considered the opinion as

slightly more negative ($M = 3.43$; $SD = .79$) than those in the front condition ($M = 3.66$; $SD = .75$). The main effect of relevance was not significant, $F = 1.86$; $p = .180$, $\eta_p^2 = .014$, nor was its interaction with the location, $F = .03$; $p = .876$, $\eta_p^2 = .000$. In sum, the present results support the rear negativity effect and show that it is more pronounced when the incoming information is personally relevant for a listener. The results also demonstrate that negative evaluation of information valence caused by the rear location of its source may spread to the interpretation of its meaning. This experiment demonstrated that in the rear condition, participants not only rated valence of consecutive utterances as more negative but also perceived the meaning of the conveyed opinion (expressed within a summary judgment on their global rating) as generally less favorable toward the perceived group (Chinese or Polish students). However, it is interesting to consider a possible alternative explanation for the obtained effects of our personal relevance manipulation (target group – Polish vs Chinese students). It is possible that our stimuli activated meta-stereotypes on intergroup perception [1]. Many studies on this issue demonstrate that people expect members of other groups to be more negative about the member of the participant's in-group (e.g. Judd, Park, Yzerbyt, Gordijn, & Muller, 2005; Yzerbyt, Judd, & Muller, 2009). Thus, sentences uttered by an outgroup member about the participants' own group could cause a tendency to interpret them as negative evaluations (or even threats) directed to own group. Interestingly, though, there was no main effect of the target group – only in an interaction with the location, and valence of the information provided behind one's back was overall evaluated lowest. However, given that the relationships between ingroup and outgroup evaluations are rather complex, such possibility should be addressed in further studies. However, the results of present study confirm that information location generally enhances negative evaluation of what is heard from behind. It should be noted however, that the observed effect sizes of the rear negativity effect on the single-item rating of the Chinese student's general opinion and the interaction

between location and relevance were smaller than expected, which again imposes caution in a final interpretation.

Study 4

The primary goal in this study was to investigate whether there is an attentional bias toward verbal messages from outside of someone's field of vision. We argue that this attentional bias would manifest itself in faster reactions (shorter RTs) to the negative verbal messages occurring behind compared with those that are located in the front. Furthermore, we argue that this effect would be especially true for verbal messages relevant for the listener. Participants listened to spoken personality traits allegedly describing them (the self-relevant condition) or another participant (the self-irrelevant condition) and the messages were played either in front of or behind them. The self-other relevance manipulation was a bogus manipulation and all participants heard identical traits considering self and other person. We measured reaction times of decisions whether each trait was positive or negative. We predicted that participants who listened to traits concerning themselves would categorize them more quickly than participants listening to traits concerning another person and even more quickly when those traits were negative and played to the rear of participants.

Method

Participants and design. The participants were 75 students (45 female) from the University of California, San Diego. The mean age of participants was $M = 20.17$ ($SD = 1.82$). This study design was a 2 (front vs. rear) $\times$ 2 (positive vs. negative) $\times$ 2 (self-relevant vs. not self-relevant) design with all factors manipulated within participants. Analysis for repeated measures design performed with PANGAEA indicated that this sample was sufficient to detect an effect at a size of $f > .12$ ($d > .23$) with power $1 - \text{Beta} > .8$ for the main effect of location and $1 - \text{Beta} > .92$ for the interaction of location with any of the remaining factors.

Procedure. All participants were tested individually. There were two parts to the study. In the first part, under the guise of investigating differences in assessment of oneself and other people, the participants were asked to complete a short personality questionnaire that was supposedly also completed by a fellow student – the previous participant. The questionnaire was A Brief Version of the Big Five Personality Inventory (Rammstedt & John, 2007) (Cronbach's $\alpha = .89$). They then completed the Sense of Control questionnaire (Lachman & Weaver, 1998b) as a buffer and answered demographic questions about age, gender, and native language. From the results of the Brief Version of the Big Five Personality Inventory (Rammstedt & John, 2007) and of the Sense of Control questionnaire (Lachman & Weaver, 1998b) we extracted for each participant the set of 36 positive and negative personality traits that they allegedly possess. This set consisted of traits that had been selected based on a pilot study where emotional reactions of 51 participants (none of whom took part in other experiments) were collected using 7-point Valence and Arousal scales (Lang, 1980). These spoken traits (see Table S2 in supporting material) were selected to form two emotional categories: 18 positive and 18 negative traits. In the second part of the study, participants in the self-relevant condition learned they would listen to traits describing their own personality (presumably communicating results of a previously completed questionnaire). In the self-irrelevant condition, the traits were presented as describing another person who took part in the study immediately before the participant. These two types of information (self-relevant and non-self-relevant) were counterbalanced between subjects. The traits were presented in two separate blocks, such that some participants first heard a set with their own traits and then traits of another person, whereas other participants heard them in the opposite order. In both blocks, the participants' task was to decide whether each heard trait was positive or negative. Half of the traits were randomly played in front of listeners and the other half were played behind their backs.

We measured response time to categorize each trait based on valence. Such procedures were successfully used in previous research (e.g., Meier & Robinson, 2004) to measure the influence of physical postures on affect. Whereas those authors presented the words at the top or bottom of a computer screen, we played our stimuli in front of or behind the participants. In the center of the screen there was a fixation point displayed for 300 ms before each trait, then for 1.5 s the personality trait was played from a speaker and participants pressed a key indicating their decision that a trait was positive or negative.

We informed our participants that the next part of the research concerned differences between the assessment of oneself and others, and that in a moment they would hear their personality questionnaire results, as well as the results of a person who took part in the study before them. Next, we seated the respondents in front of a computer screen and personality traits were played from speakers (in random order and randomly changing locations of the speaker). The setting of this part is illustrated by Figure 1B. The participants' task was to decide as quickly as possible whether each personality trait is positive (by pressing A key) or negative (by pressing L key). The assessments were made for each of the 36 personality traits. Their content and parameters collected in the previously mentioned pilot study are presented in Table 1 of the supporting material.

Results

The first two questionnaires were used for manipulations only, so their results were not analyzed. We excluded from analyses all responses over 3 *SD* above the mean (less than 1%). Next, to normalize the distribution of the response times we transformed with the natural logarithm (Ratcliff, 1993). A 2 (front vs. rear) 2 (positive vs. negative) 2 (self-relevant vs. self-irrelevant) ANOVA on the normalized response rates produced a main effect of the trait valence, $F(1, 74) = 12.66$; $p < .01$, $\eta_p^2 = .15$. Participants reacted more quickly to negative traits ($M = 7.31$; $SD = .08$) than to positive ones ($M = 7.34$; $SD = .09$). Also the main

effect of relevance was significant, $F(1, 74) = 503.24, p < .001, \eta_p^2 = .87$. Participants reacted more quickly to traits presented as their own ($M = 7.19; SD = .09$) than to those of another student ($M = 7.46; SD = .10$). The main effect of the source location was not significant, $F = .75; p = .388, \eta_p^2 = .01$. As expected, however, there was a significant interaction between the source location and valence; $F(1, 74) = 15.90, p < .001, \eta_p^2 = .18$; as well as a significant interaction between location, valence, and relevance; $F(1, 74) = 9.65, p = .003, \eta_p^2 = .12$.

As illustrated in Figure 3, response times to self-relevant personality traits played from behind were faster when the traits were negative ($M = 7.12; SD = .24$) than when they were positive ($M = 7.23; SD = .12$), $t(74) = 3.34; p < .01, d = .58, CI [.04 - .17]$. When the words were played in front, response times were faster for positive traits ($M = 7.16; SD = .14$) than for negative ones ($M = 7.22; SD = .13$), $t(74) = 2.90; p < .01, d = .44, CI [.02 - .10]$. In the rear presentation condition, the response times to self-irrelevant personality traits were faster for negative traits ($M = 7.43; SD = .10$) than for positive ones ($M = 7.49, SD = .14$), $t(74) = 3.70, p < .001, d = .49, CI [.02-.08]$. The same, however, was true for self-irrelevant personality traits when they were played in front of the participants ($M = 7.45; SD = .11$ vs. $M = 7.48, SD = .13$), $t(74) = 2.61, p < .05, d = .25, CI [.01 - .06]$.

To summarize, the results of Study 4 support our hypothesis. Location influenced evaluation, but only for self-relevant traits. If trait valence was consistent with its spatial location (“behind” for negative traits and “front” for positive traits), evaluation was facilitated (valence decisions were faster). If trait valence was inconsistent with spatial position, the evaluation was impaired (valence decisions were slower). There was no such effect for self-irrelevant traits. The study also revealed two interesting additional findings: (i) evaluation were always faster for negative traits, independent of their spatial location, and (ii) evaluations were generally faster for self-relevant traits. We will return to these findings in the general discussion.

Figure 3. Mean evaluation latency (log transformed RTs) as a function of the trait valence, its source location and relevance in Study 4. Error bars represent standard errors.

Meta-Analysis of the rear negativity effect

To estimate the general effects of the main rear negativity effect in all four studies we ran a mini meta-analysis using the JAMOV software (Meta-Analysis Beta). The data were computed using effect sizes and sampling variances, while the multiple outcomes for Study 2 and Study 3 were averaged. The results of the analysis confirmed the presence of an overall effect of the rear negativity, $d = .69$; $CI [.12 - 1.25]$; $p < .05$. The results of this analysis are presented in Figure 4 and show the robust overall effect of these four experiments.

Figure 4. Results of the meta-analysis of the rear negativity effect in Studies 1, 2, 3 and 4.

Numbers on the left represent estimated effect and numbers in parentheses represent 95% *CI*.

General Discussion

Rear Negativity Effect in Social Domain

The present series of studies document a “rear negativity effect” – a phenomenon where perceivers evaluate social information coming from a source located behind them as more negative than identical information coming from a source located in front of them. We observed this effect repeatedly for a variety of verbal messages (communications in a language incomprehensible to the listeners, neutral communications, positive or negative words spoken in participants’ native language), for a variety of dependent variables (ratings, reaction times), and among different subject populations (Poland, US). Specifically, in Study 1, Polish subjects interpreted Chinese sentences as more negative when presented behind the listener. In Study 2, Polish subjects evaluated feedback from a bogus test as indicative of poorer results when it was presented behind, rather than in front of them. In Study 3, Polish subjects evaluated the Chinese sentences as the most negative when they were played from

behind and when they supposedly described in-group (i.e., Polish) members. In Study 4, US subjects judged negative traits more quickly when the traits were supposedly describing self-relevant information and were played behind the listener.

Explanations of the effect

The current research extends previous findings that ecological, naturally occurring, sounds are detected quicker and induce stronger negative emotions when presented behind participants (Asutay & Västfjäll, 2015). Critically, the current studies document this effect in the domain of social information and show it to be stronger or limited to processing of self-relevant information, whether this relevance was induced by reference of messages to the self or to an in-group.

Our characterization of the “rear negativity” effect in the social domains is compatible with several considerations and theoretical frameworks. Most generally, the effect is consistent with a notion common in many cultures that things that take place “behind one’s back” are generally negative. However, the accounts of why this is vary – ranging from metaphor theory, simple links between processing ease and evaluation, affordance and uncertainty theories, attentional as well as emotion-appraisal accounts.

Spatial metaphors. People not only talk metaphorically, but also think metaphorically, activating mental representations of space to scaffold their thinking in a variety of non-spatial domains, including time (Torralbo et al., 2006), social dominance (Schubert, 2005), emotional valence (Meier & Robinson, 2004), similarity (Casasanto, 2008), and musical pitch (Rusconi et al., 2006). Thus, it is interesting to consider how our results fit with spatial metaphor theories. Specifically, perhaps when people hear a message, they activate a metaphor and, as a result, evaluate the information as being more unpleasant, dishonest, disloyal, false, or secretive when coming from behind than from the front. Our results suggest that reasons for the rear negativity of verbal information go beyond simple

metaphorical explanation. This is because this negativity occurs solely or is augmented for information that is personally relevant to the listener, and that it occurs even in paradigms that require fast automatic processing, leaving little time for activation of a conceptual metaphor. Of course, once the valence-to-location mapping is metaphorically established, it could manifest quickly and be stronger for personally-important information. In short, it would be useful to conduct further investigation of the metaphorical account, perhaps by manipulating the degree of metaphor activation, its specific form or its relevance.

Associative learning and cultural interpretations. The valence-location link could have metaphorical origins but could also result from an individual's personal experiences that create a mental association (Casasanto, 2009). One could potentially examine an individual's personal history and her cultural setting and see whether a rear location has linked to negative events.

Specifically, everyday experiences could lead to a location-valence association. For example, during conversations an individual may have encountered more high-status people in front of her rather than behind, thus creating an association of respect and location. Or, the individual may have experienced more sounds from behind that are associated with criticism or harassment rather than compliments.

Beyond an individual's own associative history, there is also culture. For example, European cultures used to have a strong preference for facing objects of respect (e.g., not turning your back to the monarch, always facing the church altar). As a result, sounds coming from behind may be interpreted as coming from sources of less respect.

More complex interpretative processes may also be involved. As discussed in the context of Study 3, hearing from behind from an out-group about one's own group can increase the tendency to attribute negative biases to the outgroup. It can lead then to interpreting the outgroup's utterances as being more critical or even threatening, especially

when such utterances are negative (e.g. Judd et al., 2005; Yzerbyt, Judd, & Muller, 2009).

However, these speculations are clearly post-hoc and further research is needed to understand the full pattern of results. Simila

Fluency. One simple mechanistic explanation of the current results draws on the idea that difficult (disfluent) processing lowers stimulus evaluations, while easy (fluent) processing enhances evaluations (Winkielman et al., 2003). People usually listen to sounds positioned in front. So, it is possible that sounds coming from behind are perceived as more negative because they are less fluent (or less familiar). However, fluency, besides increasing the experience of positive affect, is also manifested through the speed of processing (i.e. fluent stimuli are recognized faster). Yet, it is worth mentioning that in Study 4 we did not observe the effect of location on overall reaction times. Moreover, previous research suggests that if anything, information presented from behind is processed faster (Asutay & Västfjäll, 2015). For these reasons, and because the effect is limited to self-relevant information, the fluency approach does not explain the presented effects. However, future research may consider a potential of fluency manipulations to reduce the rear negativity effect.

Affordances. Yet another possible explanation draws on classic affordance theory suggesting that the world is perceived not only in terms of objects and their spatial relationships, but also in terms of one's possible actions (Gibson, 1950, 1966). Thus, verbal information located in the back may restrict possible actions to the listener and hence may cause negative evaluation. However, this explanation is weakened by our observations that reward negativity effect also appears when participants are seated and blindfolded, so they cannot see in the front. Further examination of this account could include a set-up that involves restricting participants' hands or using virtual reality to manipulate perspective and embodied affordances.

Auditory-Visual Integration. This account emphasizes that perception integrates different modalities, for example, auditory and visual (Suied, Bonneel, & Viaud-Delmon, 1998), with processing facilitation (shorter RT) to stimuli containing redundant bimodal information (Miller, 1982, 1986). This theory could account for why sources from behind (which are invisible) are processed slower, but it does not account for changes in valence and why the effect occurs when participants are blindfolded (Study 1).

Uncertainty-Ambiguity. Similarly, verbal information coming from the back could be more uncertain or ambiguous. One simple reason for this is that there is simply less information about it (e.g., source cannot be visually verified). This could lead to negative reactions related to uncertainty aversion (Glass & Singer, 1972; Klein, Fencil-Morse, Seligman, 1976; Cohen, 1986) or ambiguity avoidance (Curley, Yates & Abrams, 1986). Again, this possibility is somewhat less likely given the blindfold aspect in Study 1, but should be investigated.

Attentional and Control Mechanisms – Alarm meets Appraisals. The most plausible account of the current findings, in the context of previous research, seems to be a combination of basic attention processes with more complex appraisals. The attention account suggests higher sensitivity towards objects from outside the visual field, including the rear, so that attention can be quickly shifted in case of emotionally significant information – a form of an early warning system (e.g., Juslin & Västfjäll, 2008; Asutay & Västfjäll, 2015). Indeed, people appear to have an orienting reflex when hearing something behind them (e.g., turning head, perking ears). Consistently, Alain and Arnott (2011) showed that auditory spatial processing taking place in the dorsal pathway can have the function of orienting the visual system to a particular location of interest.

The above explanation is usually applied to simple stimuli but could be translated to the social domain where people are sensitive to perceived lack of control (deCharms, 1969).

People feel that they have control only over what is visible to them and objects in the back are less controlled (Levinson, 1993). The negative consequences of lack of control in social and emotional domains are well-documented (Glass, Singer, Leonard, Krantz, Cohen & Cummings, 1973; Whalen, 1998; Whitson & Galinsky, 2016). However, note that the current results go beyond the low-level version of the alarm theory, which assumes rudimentary auditory bias and recruitment of evaluative processes. If negative marking would only be a simple function of an alarm system, it would not depend on self-relevance of information. Hence, it would create negative evaluation of all sounds coming from behind (Studies 3 and 4 did not demonstrate such effects).

We believe our data are best explained by an account that is a blend of an alarm response and more complex appraisal processes (Lazarus, 1991; Scherer, 2001a; 2001b). Such account explains why the effect occurs and why it is potentiated in conditions of self-relevance, as Studies 3 and 4 showed. It also suggests involvement of more evaluative rather than affective processes that can occur in simple, fast valence detection tasks (Study 4) and extend to more complex evaluations and inferences. The evaluative, rather than merely affective nature of the processes is suggested by the results of Study 2 where measurements of self-reported feelings did not show any changes induced by the spatial location of verbal information. This renders the general “affective-spillover” explanation of rear negativity rather implausible (“feelings as information” theory, Schwarz, 2012).

Conclusion

Clearly, the mechanisms underlying the current phenomenon need further research. However, for now it appears that spatial location of verbal messages is linked with valence, such that information coming from behind is interpreted as more negative than the same information coming from the front. Importantly, our findings reveal the social nature of this seemingly “basic” effect -- it occurs across a variety of social manipulations and stimuli and

is potentiated by self-relevance. It should be noted, however, that even though the rear negativity effect was replicated several times with sufficient power, the effect size of the effect varied substantially between studies and in some cases observed effect sizes were smaller than predicted (Study 2, 3). This suggests that the source localization effects may be quite subtle. Thus, caution is advised in interpreting the robustness of these effects and there is a need for further investigation with high-powered replications. Nevertheless, we confirmed the presence of the main rear negativity effect with results of the meta-analysis in all four studies.

The social dimension of the rear negativity effect deserves further attention, as most sounds that people receive are inherently social in nature. Although our results demonstrate that auditory source location can influence interpretation even in the absence of social factors, awareness of this bias in a rich social context may be beneficial beyond the basic scenarios described in the present article. For instance, in a communication area, people who consistently talk to each other face to face have greater satisfaction with the conversation (Tannen, 2009). Relatedly, the rear negativity effect might also bear on how people with various impairments interpret the information around them. Specifically, future studies could examine if people with limited mobility are affected by their inability to turn to the information source, or whether blind people are immune to this source of bias (this hypothesis could be further examined with participants partially sighted or born blind). Further studies may also identify biases facing students, or conference participants, who are seated in the back, as their comments could be evaluated less positively by audiences. Similarly, it would be worth testing if a member of a team (emergency workers, mountaineers, soldiers, peloton biker) interprets a message from a back as more negative or threatening. If further research confirms these possibilities, it may lead us to pay more attention to spatial position and adjust how we communicate behind someone's back. As

such, the “rear negativity” effect highlights the tight interface between attentional, evaluative, and social processes.

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Supporting materials to accompany the manuscript: The Rear Negativity: Verbal Messages
Coming from Behind are Perceived as More Negative

S1. Additional variables measured in Study 3. Participants were also asked to comment on 8 statements regarding personality traits (4 positive and 4 negative) of the Chinese or Polish students, according to the supposed speaker:

“In your opinion, does the Chinese student believe that Chinese/Polish students are: hardworking, arrogant, selfless, greedy, haughty, ambitious, helpful, lazy” (on a 5-point scale: 1 = *strongly disagree*, 5 = *strongly agree*).

Generally, the participants more strongly endorsed the four positive personality traits (hardworking, selfless, ambitious, helpful; Cronbach's $\alpha = .65$; $M = 3.38$; $SD = .63$) than the four negative ones (arrogance, greed, haughtiness, laziness; Cronbach's $\alpha = .62$; $M = 2.60$; $SD = .61$), $t(130) = 8.30$; $p < .001$; $CI [.59 - .96]$; $d = 1.26$) both for Polish students (an in-

group) and Chinese students (an out-group). The ANOVA test in a 2 (location: front vs. back) x 2 (subject: an in-group vs. an out-group) design showed another significant impact of the localization of the source of the voiced opinion on positive personality traits. Regardless of the message subject, participants hearing the message from behind endorsed positive personality traits of the students less strongly ($M = 3.26$; $SD = .67$) than those who heard it from the front ($M = 3.50$; $SD = .56$), $F(1, 127) = 6.21$, $p = .014$, $\eta^2 = .047$. The analysis also showed significant differences between the message content – regardless of the sound source location, participants who thought they heard a message about the out-group perceived it to describe more positive personality traits of the out-group ($M = 3.48$, $SD = .54$) than participants hearing a message about the in-group did respectively ($M = 3.25$, $SD = .70$), $F(1, 127) = 4.75$, $p = .031$, $\eta^2 = .036$. A pairwise comparison (Keppel & Wickens, 2004) showed that there were no significant differences between the perceived number of positive and negative personality traits assigned to both groups when the message was played from the front. However, when it was played from behind, participants perceived there to be more positive traits assigned to the speaker's in-group (i.e. Chinese students, $M = 3.43$; $SD = .59$), than his out-group ($M = 3.04$; $SD = .71$), $t(130) = 8.30$; $p < .001$; $CI [0.59 - 0.96]$; $d = .60$.

No differences were found between perceived general opinion of the speaker on the participants' out-group regardless of the sound location. However, when speaking supposedly about Polish students, the participants considered the speaker to assign more positive traits to them when the message was heard from the front ($M = 3.46$; $SD = .64$) than when it was played from behind ($M = 3.04$; $SD = .71$; $t(60) = 2.44$; $p = .018$; $CI [-.76 - (-.08)]$; $d = .62$).

The observed result pattern did not occur when analyzing negative personality traits. However, significant effect of the message content was found: regardless of the sound source localization, participants assessed that the speaker attributed more negative personality traits to the participants' in-group ($M = 2.76$; $SD = .61$) than their out-group ($M = 2.46$; $SD = .59$;

$F(1,127) = 8.29; p = .004, \eta^2 = .06$.) Additionally, pairwise comparison analysis showed that participants considered the messages to contain more negative personality traits when concerning their in-group ($M = 2.79; SD = .60$) than their out-group ($M = 2.43; SD = .60; t(67) = 2.45; p = .017; CI [-.65 - (-.07)]; d = .60$) when the message was played from behind.

Table S2. *Stimuli Information from Study 4, Mean Valence and Mean Arousal Ratings*

Stimulus	Mean Valence (<i>SD</i>)	Mean Arousal (<i>SD</i>)
Patient	1.98 (.84)	3.39 (.90)
Agreeable	2.06 (.86)	3.25 (1.10)
Flexible	2.16 (.83)	3.71 (1.03)
Discreet	2.73 (.72)	4.02 (.97)
Friendly	1.65 (.74)	3.65 (1.15)
Capable	1.63 (.53)	3.31 (1.11)
Kind	1.59 (.75)	3.88 (1.23)
Active	2.22 (.90)	3.08 (1.18)
Modest	2.41 (.75)	3.96 (.89)

Calm	2.43 (14.51)	2.43 (14.51)
Cheerful	1.63 (.75)	3.53 (1.19)
Gentle	1.88 (.86)	2.42 (.98)
Tasteful	2.25 (1.04)	3.39 (.83)
Healthy	1.67 (.86)	3.55 (1.24)
Warm	1.90 (.96)	3.61 (1.08)
Fair	2.27 (.87)	3.86 (1.04)
Clever	1.90 (.78)	3.53 (1.15)
Independent	1.98 (.88)	3.49 (1.21)
Rude	3.55 (.88)	2.76 (1.16)
Desperate	3.96 (.96)	3.12 (1.17)
Rough	3.82 (.74)	3.45 (.99)
Shy	3.54 (.77)	3.08 (1.13)
Anxious	3.88 (.84)	2.73 (1.15)
False	3.80 (.85)	3.24 (1.10)
Slow	3.49 (.80)	3.59 (1.06)
Cold	3.63 (.96)	3.61 (1.02)
Cruel	4.29 (.78)	3.29 (1.10)
Disrespectful	4.08 (.77)	3.22 (1.06)
Dull	3.73 (.72)	4.10 (.90)
Critical	3.33 (.79)	3.22 (1.03)
Naughty	2.98 (1.09)	3.29 (1.08)

Crude	3.55 (.88)	3.63 (.82)
Stupid	4.37 (.80)	3.59 (.1.02)
Dirty	3.59 (.94)	3.18 (1.03)
Vulgar	4.29 (.87)	3.12 (.90)
Clumsy	3.25 (.72)	3.08 (.87)

Figure 1. (A) Design of all studies. Two loudspeakers were located 1.5 m from the participant. One of the loudspeakers was located directly in front of the listener while the other one was in the back. (B) Timeline of the session in Study 4. Participants indicated the trait valence as quickly and accurately as possible during the sound presentation.

Figure 2. Mean ratings of the spoken information valence as a function of the location of its source and relevance. Error bars represent standard errors (Study 3).

Figure 3. Mean evaluation latency (log transformed RTs) as a function of the trait valence, its source location and relevance in Study 4. Error bars represent standard errors.

Figure 4. Results of the meta-analysis of the rear negativity effect in Studies 1, 2, 3 and 4.

Numbers on the left represent estimated effect and numbers in parentheses represent 95% CI.

Table 1. Descriptive statistics, independent sample *t*-test results as a function of condition, effect sizes and 95% CIs for variables measured in Study 2

	front condition <i>n</i> = 19 <i>M</i> (<i>SD</i>)	rear condition <i>n</i> = 19 <i>M</i> (<i>SD</i>)	<i>t</i>	<i>d</i>	<i>CI</i>
Satisfaction with the test results	3.31 (.58)	2.99 (.52)	1.76*	.58	(-.68, .05)
Test validity	4.53 (1.05)	3.92 (.69)	2.18*	.70	(-1.20, -.04)
Self-esteem	5.45 (.55)	4.99 (.83)	1.97*	.65	(-.92, -.01)

Note: Next to the variable name in the first column in parentheses the answer scales are given. For *t*-tests one-tailed tests were used. Within each row, means with different subscripts are significantly different, ****p* < .001, ***p* < .01, **p* < .05.

^[1] we thank an anonymous reviewer who suggested this explanation during the review process