intensity" or "friendliness-threat". Differences in conveyed intensity that favor "hostile" features might thus be the cause of differential outcomes regarding friendly faces. The same can be said of the found perceptual differences favoring threat (in the *eyebrows* feature). Even granting that the two sorts of differences are not independent, they may plausibly reinforce each other in determining a perceptual threat advantage in the current set of stimuli.

Irrespective of these perceptual differences, significantly higher importance of "threatening" as compared to "friendly" levels was established for every schematic feature. This outcome agrees with Öhman's claim of a higher psychological significance of threat (and thence, of fear), but it is independent from any assumptions regarding perceptual matching of the stimuli. Therefore, it does not imply that the threat advantage arising in visual search with schematic faces rests on an emotion-based mechanism, nor that the happy advantage for photographed faces has a perceptual origin. To establish that would require suitable perceptual control (still, the present approach illustrates how functional measurement sets proper requirements to achieve such a control).

Finally, just as the importance of schematic features could be measured independently from scale values, so can the importance of facial features of realistic faces be similarly dealt with. The generality and ecological significance of findings obtained from schematic stimuli could thereby be more directly (and quantitatively) assessed.

References

Anderson, N. H. (1981). *Foundations of information integration theory*. New York: Academic Press.

Anderson, N. H. (1982). *Methods of information integration theory*. New York: Academic Press.

Anderson, N. H. (2001). *Empirical direction in design and analysis*. Mahwah, NJ: Lawrence Erlbaum.

Juth, P., Lundqvist, D., Karlsson, A., & Öhman, A. (2005). Looking for foes and friends: Perceptual and emotional factors when finding a face in the crowd. *Emotion, 5(4)*, 379-395.

Kirita, T., & Endo, M. (1995). Happy face advantage in recognizing facial expressions. *Acta Psychologica, 89*, 149-163..

Lundqvist, D., Esteves, F., & Öhman, A. (1999). The face of wrath: Critical features for conveying facial threat. *Cognition and Emotion, 13(6)*, 691-711.

Lundqvist, D., Esteves, F., & Öhman, A. (2004). The face of wrath: The role of features for conveying facial threat. *Cognition and Emotion, 18(2)*, 161-182.

Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: A threat advantage with schematic stimuli. *Journal of Personality and Social Psychology, 80(3)*, 381-396.

Öhman, A., Carlsson, K., Lundqvist, D., & Ingvar, M. (2007). On the unconscious subcortical origin of human fear. *Physiology & Behavior, 92,180*-185.

Weiss, D. J. (2006). *Analysis of variance and functional measurement*. New York: Oxford University Press.

Zalinski, J. & Anderson, M. (1987). *AVERAGE Program & Manual*. San Diego: University of California.

Acknowledgment

This work was supported by grant POCI/PSI/60769/2004, from the *Portuguese Foundation for Science and Technology - FCT/POCI 2010*.

DISCRIMINABILITY AND PERCEIVED EMOTIONALITY OF FACIAL EXPRESSIONS: THE ROLE OF THE PARTICULAR FACE STIMULI

Tonya S. Pixton

Department of Psychology, Stockholm University, SE-106 91 Stockholm, Sweden

tonya.pixton@psychology.su.se

Abstract

The purpose of this study was to examine the perceived emotionality of a set of standard faces. Seventy participants rated 90 pictures of facial expressions (presumably angry, happy, and neutral) from the NimStim Set of Facial Expressions (Tottenham et al., in press) on angriness (Block 1), happiness (Block 2), and perceived emotionality (Block 3). Neutral faces were rated as somewhat angry in Block 1 and as somewhat sad in Block 2. In Block 3, angry faces were rated as only slightly more emotional than happy faces. However, happy faces differed more from neutral faces than did angry faces in terms of the specific emotion (Blocks 1, 2). Together with Pixton's (2007) results, this suggests that d' *is dependent only on the intensity of emotion, not on the kind of emotion; therefore, the greater discriminability for happy faces, found in the literature, might be due to the particular stimulus faces used.*

Although emotional expressions are not discrete but have endless variety, six basic emotions have been identified: happiness, sadness, disgust, anger, surprise, and fear. These six emotional expressions are considered not to be culturally bound, but universal (e.g., Darwin, 1872/1998; Ekman & Friesen, 1971), being recognized across all cultures. There are, however, critics who state that emotional expressions are context dependent, and that there are only broad and not discrete emotion categories; the perception of emotional expressions varies across culture (e.g., Russell, 1994) and situation (e.g., Carroll & Russell, 1996).

Therefore, the perception of emotional expressions can be a matter of relativism rather than a matter of absolutism (Russell & Fehr, 1987). When the same facial expression is presented in two different situations the perception of the expression may be interpreted as different expressions. Russell and Fehr suggest that, within an emotional face space, there may be a type of anchor effect against which the other stimuli are rated. When a presumably neutral facial expression is presented in a group of happy facial expressions the neutral expression tends to be perceived as being sad, and when a presumably neutral facial expression is presented in a group of angry expressions the neutral expression is perceived more towards angry. Similar results were found by Lee, Kang, Park, Kim, and An (2008). Carrera-Levillain and Fernandez-Dols (1994) and Shah and Lewis (2003) also suggest that a neutral expression may represent an emotion in and of itself, not a zero-middle point.

If indeed a neutral expression may not be neutral, results that are reported in the literature should be examined more closely. For example, there is a body of literature that discusses a happy-superiority effect (e.g., Leppänen & Hietanen, 2004; Leppänen, Tenhunen, & Hietanen, 2003; Pixton, 2007), where there appears to be a tendency to better identify happy faces compared to other emotional expressions, such as angry and sad. Leppänen et al. discuss the possibility that the advantage comes from the manner in which the stimuli are presented, so that there is a greater advantage when happy faces are presented with angry faces; however, they did not directly examine the potential effects of stimuli in and of themselves. Leppänen and Hietanen discuss the saliency of the particular emotional expression, but do not discuss the saliency of the particular stimuli. Pixton (2007) used signal detection analysis to test the manner in which shifts in sensitivity (*d*') occur across presentation time, emotional expression, and gender of face stimuli. Pixton reported a happy-superiority effect, but did not discuss the potential effect of the particular stimuli.

Therefore, the purpose of the present study was twofold, (1) to examine whether the manner in which the stimuli are presented effects the perception of those particular stimuli and (2) to examine whether Pixton's (2007) results shift as a factor of a greater difference in the distance between happy and neutral expressions than the distance between angry and neutral expressions.

Method

Participants. Seventy undergraduate students, ranging between 19 and 50 years (M = 27.9, SD = 8.2) from the Department of Psychology at Stockholm University, participated in partial fulfillment of course requirements. There were 22 men ranging between 19 and 48 years (M = 27.8, SD = 8.8) and 48 women ranging between 19 and 50 years (M = 28.0, SD = 8.0). Participants gave informed consent and had normal or corrected-to-normal vision. There were no significant differences between men and women regarding age [$t(68) = -0.10$, $p = .92$].

Stimuli and Apparatus. Ninety (30 angry, 30 happy, and 30 neutral) faces were used from the NimStim Set of Facial Expressions (Tottenham et al., in press). For each emotion, there were 15 men and 15 women, with the same poser for each emotion. The faces were in color and included the entire face with hairstyles and without facial hair or eyeglasses. The pictures consisted of 500 x 650 pixels and were presented on a black background, measured at 0.35 cd/m^2. On the monitor the pictures measured 12.3 x 16.0 cm with a viewing angle of 8.39° x 10.91° at a distance of 33.1 in (84 cm), which was held constant by a chin rest.

The experiment was controlled by a Hewlett-Packard PC with a 21 in. ViewSonic® PerfectView™ flatscreen CRT screen at 160 Hz; the presentation of the experiment was controlled with Matlab 2006a with the Psychophysics Toolbox extensions (Brainard, 1997; Pelli, 1997). A 3-sided black viewing box with an opening for the monitor was used to help reduce reflections. Responses were made using a HP-PC mouse.

Design and Procedure. The 90 pictures were presented individually in three different blocks. Within each block, the participants rated the stimuli on an angriness scale (Block 1: friendly to neutral to angry), a happiness scale (Block 2: sad to neutral to happy), and an emotionality scale (Block 3: not at all emotional to very emotional). There was an 11-point rating scale for Block 1 (5 = *friendly*, 0 = *neutral*, 5 = *angry*) and Block 2 (5 = *sad*, 0 = *neutral*, 5 = *happy*); for Block 3, there was a 6-point rating scale (0 = *not at all emotional*, 5 = *very emotional*).

The stimuli were presented pseudo-randomly within each block, and block order was counter-balanced across participants. At the beginning of each block, instructions appeared on the screen. Each trial consisted of one face and one scale below the face. The scale consisted of positive numbers with descriptors for the middle and outer values. The picture and scale remained on the screen until the participant answered. There was a one-second inter-trial-interval with 270 trials (90 per block) for one 30-minute session.

Each participant entered a dimly-lit room, read written instructions, and signed consent forms. They were then given oral instructions. Participants were asked to judge and rate to which degree each face displayed an emotional expression by clicking on a number of the scale. The succeeding trial would not begin until they had entered their answer; there was no time limit, but they were to answer as accurately and as quickly as possible.

Results

Mean values were calculated for each emotion and gender of the face stimuli and their combinations in three blocks (see Table 1); the differences between the scale values for each face type in the different blocks were also calculated. The means were submitted to a 2 (gender-of-face: male and female) x 3 (emotion-of-face: angry, neutral, and happy) x 3 (Block Type: angriness, happiness, emotionality) repeated measures ANOVA (multivariate approach with Pillai tests) with gender-of-participant as a between-participant factor.

The main effect of gender-of-face was not significant ($p = .23$). There was a significant main effect of emotion-of-face [$F(2,67) = 251.59$, $p < .0001$, partial $\eta^2 = .88$] and Block type [$F(2,67) = 833.86$, $p < .0001$, partial $\eta^2 = .96$]. A pairwise comparison with Bonferroni adjustment showed a significant difference between each of the three emotional expressions ($p < .0001$ for each comparison) and for Block type, between Block 1 and Block 3 ($p < .0001$) and between Block 2 and Block 3 ($p < .0001$).

There was, also, a significant interaction between gender-of-face and Block Type [$F(2,67) = 16.77$, $p < .0001$,partial $\eta^2 = .33$] and emotion-of-face and Block Type [$F(2,67) = 407.32$, $p < .0001$, partial $\eta^2 = .96$].

There was neither a significant interaction between gender-of-face and emotion-of-face ($p = .06$), nor a significant triple interaction between gender-of-face, emotion-of-face, and Block Type [$F(2,65) = 23.97$, $p < .0001$, partial $\eta^2 = .60$], and the between-participant effect was not significant ($p = .95$).

Mean Difference Values. The mean difference (*MD*) values were then submitted to paired sample *t*-tests. There was a significant difference between the *MD* of angry and neutral faces (*MD* = 2.72) in Block 1 and the *MD* of happy and neutral faces (*MD* = 3.66) in Block 2 [$t(69) = -6.90$, $p < .0001$]; there was a greater distance between happy and neutral faces when the participants rated the stimuli in Block 2 than between angry and neutral faces in Block 1. Additional evidence showed that there was a significant difference between the mean-rating of neutral faces (see Table 1) in Block 1 and Block 2 [$t(69) = 8.04$, $p < .0001$]. For Block 3, the *MD* of happy and angry faces was not significant ($p = .36$).

Interestingly, in a one-sample *t*-test against zero, the *MD* of male and female faces was significant in Block 2 (*MD* = 0.10) [$t(69) = 4.00$, $p < .0001$] and Block 3 (*MD* = -0.13) [$t(69) = -5.27$, $p < .0001$], but not in Block 1 (*MD* = -0.03) ($p = .35$). Male faces (M = 0.04) were rated slightly happier than female faces (M = -0.06); however, female faces (M = 2.66) were rated as being more emotional than male faces (M = 2.57).

Table 1. *Mean Values (and Standard Deviations) for Emotion Face Types of Rated Emotional Expression and Perceived Emotionality in Three Block Types*

	Block Type		
Face Type	Block 1: Angriness	Block 2: Happiness	Block 3: Emotionality
Female-Happy	-3.31 (0.63)	3.05 (0.64)	3.37 (0.61)
Male-Happy	-3.08 (0.67)	2.90 (0.67)	3.45 (0.86)
Female-Angry	2.95 (0.80)	-2.39 (1.23)	3.53 (0.88)
Male-Angry	2.79 (0.85)	-2.25 (1.14)	3.35 (0.61)
Female-Neutral	0.24 (0.44)	-0.85 (0.71)	1.10 (0.87)
Male-Neutral	0.07 (0.46)	-0.52 (0.58)	0.89 (0.81)

Standardized d′. Results from Pixton (2007) (see Figure 1A) were reanalyzed. In Pixton's study, sensitivity (d'), which is the measure of ability to discriminate between target (emotion-of-face) and non-target (neutral) stimuli, was calculated as $d' = z(H) - z(F)$ (Macmillan & Creelman, 2005). H (hit rate) was the proportion of answering "yes" on emotional-face trials, F (false-alarm rate) was the proportion of answering "yes" on neutral-face trials, and z was the corresponding standard normal deviate.

The d' was standardized and calculated separately for angriness and happiness trials. For angriness trials, standardized d' was calculated with the d' for each gender-anger combination for all presentation times and dividing by the *MD* of female-angry and female-neutral faces (*MD* = 2.71) and of male-angry and male-neutral faces (*MD* = 2.72) in Block 1. Likewise, standardized d' for happiness trials was calculated with the d' for each gender-happy combination for all presentation times and dividing by the *MD* of female-happy and female-neutral faces (*MD* = 3.90) and of male-happy and male-neutral faces (*MD* = 3.42) in Block 2.

The new d' per scale unit was then submitted to a 2 (gender-of-face: male and female) x 2 (emotion-of-face: angry and happy) x 3 (Presentation Time: 6.25, 12.50, 18.75, 25.00, and 31.25 ms) repeated measures ANOVA (multivariate approach with Pillai tests) with gender-of-participant as a between-participant factor.

There was a significant main effect of gender-of-face [$F(1,55) = 56.51$, $p < .0001$, partial $\eta^2 = .51$], emotion-of-face [$F(1,55) = 5.80$, $p = .02$, partial $\eta^2 = .95$], and presentation time [$F(4,52) = 113.23$, $p < .0001$, partial $\eta^2 = .90$] (see Figure 1B). A pairwise comparison with Bonferroni adjustment showed that there was a significant difference within each pair of presentation times ($p < .0001$ for each comparison). There was a significant interaction between gender-of-face and emotion-of-face [$F(1,55) = 16.43$, $p < .0001$, partial $\eta^2 = .23$], between gender-of-face and presentation time [$F(4,52) = 27.17$, $p < .0001$, partial $\eta^2 = .68$], and between emotion-of-face and presentation time [$F(4,52) = 11.20$, $p < .0001$, partial $\eta^2 = .46$]. There was no significant triple interaction between gender-of-face, emotion-of-face, and presentation time ($p = .19$), nor the between-participant effect ($p = .95$).

Post-hoc *t*-tests with Bonferroni corrections were performed for each combination of gender- and emotion-of-face for each of the presentation times. There was no significant difference at 6.25 ms. At 12.25 ms, there was a significant difference between female-angry and male-happy ($p < .05$) and between male-angry and male-happy ($p < .0001$). At 18.75 ms, there were significant differences between female-angry and female-happy ($p = .002$), female-angry and male-angry ($p < .0001$), female-angry and male-happy ($p < .0001$), and female-happy and male-happy ($p = .02$). These four significant differences were the same for 25.00 and 31.25 ms; d' per scale unit was significantly lower for female-angry and female-happy faces ($p < .0001$).

Euclidean Standardized d′. In a similar manner, d' (Pixton, 2007) was recalculated and standardized with the Euclidean distance (*ED*) between each emotional face and the corresponding neutral face in the 3-dimensional space of Angriness, Happiness, and Emotionality (female-angry/female-neutral faces, *ED* = 3.95; male-angry/male-neutral faces, *ED* = 4.05; female-happy/female-neutral faces, *ED* = 5.74; male-happy/male-neutral faces, *ED* = 5.31).

A similar pattern of results was found (see Figure 1C); there was a significant main effect of gender-of-face [$F(1,56) = 36.71$, $p < .0001$, partial $\eta^2 = .40$], and presentation time [$F(4,53) = 11.13$, $p < .0001$, partial $\eta^2 = .90$], but not for emotion-of-face ($p = .07$). A pairwise comparison with Bonferroni adjustment showed that there was a significant difference within each pair of presentation times ($p < .0001$ for each comparison). There was a significant interaction between gender-of-face and emotion-of-face [$F(1,56) = 25.97$, $p < .0001$,

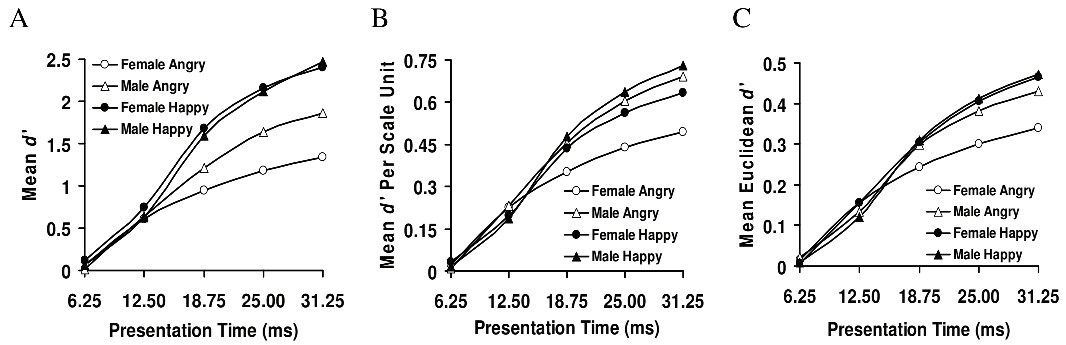

Figure 1. Mean d' (A) (Pixton, 2007), Mean d' Per Scale Unit (B), and Mean Euclidean d' (C) Values for Female and Male Emotional Faces Across Presentation Time in Milliseconds (ms)

partial $\eta^2 = .32$], between gender-of-face and presentation time [$F(4,53) = 22.12$, $p < .0001$, partial $\eta^2 = .63$], and between emotion-of-face and presentation time. There was a significant triple interaction [$F(4,53) = 3.12$, $p = .02$, partial $\eta^2 = .19$].

Post-hoc *t*-tests with Bonferroni corrections were performed for each combination of gender- and emotion-of-face for each of the presentation times. There was no significant differences at 6.25 ms. At 12.25 ms, there was a significant difference between female-angry and male-happy ($p < .01$) and between male-angry and male-happy ($p < .01$). At 18.75 ms, there were significant differences between female-angry and female-happy ($p = .002$), female-angry and male-angry ($p < .0001$), and female-angry and male-happy ($p < .0001$). These three differences were significant at 25.00 ($p < .0001$), and between female-happy and male-happy ($p < .05$). The same was found at 31.25 ms ($p < .0001$).

Discussion and Conclusion

The first aim of the present study was to examine whether the manner in which the stimuli are presented affect the perception of those particular stimuli, in particular, how a presumably emotional expressions shift in relation to the judgment task. The second aim was to examine whether the results from Pixton (2007) shift as a factor of a greater perceptual difference between happy and neutral expressions than the perceptual distance between angry and neutral expressions. The results of the present study indicate that presumably neutral facial stimuli may not be neutral. Therefore, neutral expressions might be, as it has been previously suggested (e.g., Carrera-Levillain & Fernandez-Dols, 1994; Shah & Lewis, 2003), an emotion in and of itself and not a zero-middle point of emotional expressions. In addition, as Russell and Fehr (1987) and Lee et al. (2007) have suggested, the results in the present study indicate that the neutral expressions were judged as being more towards angry when rating angriness and as being more towards sad when rating happiness, which suggests that the difference between happy and neutral is greater than the distance between angry and neutral expressions.

Although intensity and saliency of emotional expressions, as well as methodological questions, have been mentioned in the literature (e.g., Leppänen & Hietanen, 2004; Leppänen, Tenhunen, & Hietanen, 2003), it does not appear that stimulus quality of the particular stimulus set has been discussed. When considering the results found in Pixton's (2007) study, the results from the present study indicate that sensitivity to emotional expressions is due to the intensity of the emotional expression of the stimuli and not to the emotion itself. Given that the present results show a greater distance between happy and neutral face stimuli than between angry and neutral face stimuli, Pixton's results become clearer; participants can discriminate happy from neutral face stimuli easier than they can discriminate angry from neutral face stimuli. Therefore, *d*' was higher on happy trials than on angry trials, although the task was only for the participants to determine whether the face was emotional or not. After standardization of *d*', the happy-superiority advantage seems to be decreased, in that there is no difference between male-angry and male-happy faces. This indicates that there might not be a superiority effect of emotion, but a superiority of particular stimuli.

However, there seems to be a partial happy-superiority effect, in that *d*' for female-angry face stimuli remained lower than for the other stimuli. This result, however, should be taken with caution; there might be something specific occurring with the female-neutral facial stimuli. For example, the stimuli might not be equivalent to the male-neutral facial stimuli, thus again creating a larger difference between female-angry and female-neutral face stimuli than the difference between male-angry and male-neutral face stimuli.

References

Brainard, D. H. (1997). The Psychophysics Toolbox. *Spatial Vision, 10*, 433-436.

Carrera-Levillain, P., & Fernandez-Dols, J. M. (1994). Neutral faces in context: Their emotional meaning and their function. *Journal of Nonverbal Behavior*, *18*, 281-299.

Carroll, J. M., & Russell, J. A. (1996). Do facial expressions signal specific emotions? Judging emotion for the face in context. *Journal of Personality and Social Psychology*, *70*, 205-218.

Darwin, C. (1998). *The expression of the emotions in man and animals*. Harper Collins Publishers. (Original work published 1872).

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, *17*, 124-129.

Lee, E., Kang, J. I., Park, I. H., Kim, J., & An, S. K. (2008). Is a neutral face really evaluated as being emotionally neutral? *Psychiatry Research*, *157*, 77-85.

Leppänen, J., & Hietanen, J. (2004). Emotionally positive facial expressions are recognized faster than negative facial expressions, but why? *Psychological Research*, *69*, 22-29.

Leppänen, J., Tenhunen, M., & Hietanen, J. (2003). Faster choice-reaction times to positive than to negative facial expressions: The role of cognitive and motor processes. *Journal of Psychophysiology*, *17*, 113-123.

MacMillan, N. A., & Creelman, C. D. (2005). *Detection theory: A user's guide* (2nd ed.). Mahwah, NJ: Erlbaum.

Pelli, D. G. (1997). The Video Toolbox software for visual psychophysics: Transforming numbers into movies. *Spatial Vision*, *10*, 433-436.

Pixton, T. S. (2007). Signal detection analysis of the perception of happiness and angriness in briefly presented faces. In Mori, S. Miyaoka, T. Wong. W. (Eds.), *Fechner Day 07* (pp. 421-426). Tokyo, Japan: International Society for Psychophysics.

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

Russell, J. A., & Carroll, J. M. (1999). On the bipolarity of positive and negative affect. *Psychological Bulletin*, *125*, 3-30.

Russell, J. A., & Fehr, B. (1987). Relativity in the perception of emotion in facial expressions. *Journal of Experimental Psychology: General*, *116*, 223-237.

Shah, R., & Lewis, M. B. (2003). Locating the neutral expression in the facial-emotion space. *Visual Cognition*, *10*, 549-566.

Tottenham, N., Tanaka, J. W., Leon, A. C., McCarry, T., Nurse, M., Hare, T. A., Marcus, D. J., Westerlund, A., Casey, B. J., & Nelson, C. (in press). The NinStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research*.

DO THE PROCESSING OF ARABIC NUMBERS AND NUMBER WORDS DIFFER IN TASKS OF MAGNITUDE?

Merav Ben Nathan and Daniel Algom
Department of Psychology, Tel-Aviv University
Merav20@gmail.com

Abstract

Virtually all numbers that people experience in everyday life appear either as Arabic numerals or as verbal names. The two notations may engender different kinds of processing. In order to tap them, an Arabic number and a number word appeared on a trial, and the observer's task was to decide if the Arabic number was larger or smaller than a standard. In a complementary condition, the relevant number for comparison was the number word. Comparisons with Arabic numbers were free of interference from the irrelevant number words. In contrast, the comparisons of number words were affected by the irrelevant Arabic numerals. This pattern of results supports Dehaene's (1992) triple code model by which Arabic but not verbal numerals have privileged access to an analog-magnitude representation.

In the current study we tested the hypothesis that the processing of numbers depends on the task at hand and on the notation in which the numbers appear. People use numbers in a variety of tasks. Sometimes they merely name or read them just like they do words. At other times people must retrieve the arithmetic properties of numbers when, for example, they compare a number to another number in magnitude. Numbers also appear in various dressings. Two of the most popular are Arabic numerals and number words. The two notations may engender different kinds of processing. Arabic numbers are most closely associated with the rules and operations of arithmetic. Verbal numbers, by contrast, form part of the vocabulary of ordinary language. They are words whose processing is subject to known principles of reading and understanding words. Both variables, task and notation, have been tested in the literature, although not in a fully comprehensive manner. In this study, we consider a hitherto untested condition: judgments of magnitude with Arabic and verbal numerals.

Our tool was an adaptation of the Stroop task (Stroop, 1935) into numerical cognition. Two numbers were presented on each trial, an Arabic numeral and a number word. In one block, the relevant stimulus for responding was the Arabic numeral. In a complementary block the target stimulus was the number word. The irrelevant numeral conveyed the same value on half of the trials and a different value on the remaining trials. The ability to ignore the task irrelevant numeral was measured through the Stroop effect: the difference in performance with the target numeral on congruent (the two numbers match in magnitude) and incongruent (the two numbers conflict) trials. Because Arabic numbers are strongly associated with the semantic of numbers (Dehaene, 1992) we expected Arabic numbers to be more immune to intrusions from the number words than vise versa. This pattern is expected especially as the present task concerns numerical magnitude. We expected to record large Stroop effects for number words but much smaller effects with Arabic numbers.