

INDIVIDUAL AND HEMISPHERIC DIFFERENCES IN
AFFECTIVE AND HUMOR JUDGMENTS

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Individual and Hemispheric Differences in Affective and Humor Judgments

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Abstract

A sense of humor involves both cognitive and emotional processes. The purpose of this study was to examine individual differences in emotion, cognition and humor. Participants ($N = 50$) completed two computerized tasks. One task was a hemifield presentation task designed to examine the participants' schematic emotional processing system (Schaefer, 2003), where participants were asked to make forced-choice valence responses to humorous stimuli presented briefly in the right or left visual fields. The other task was designed to arouse the participants' propositional emotional processing system and consisted of participants making humor ratings for the same pictures presented for an unlimited amount of time at central fixation. Participants also completed the Interpersonal Reactivity Index (IRI) (Davis, 1980) in order to determine whether cognitive and emotional indices of empathy were related to responding in either of the tasks. The valence data shows a relationship between forced choice judgments and the IRI Fantasy subscale. Gender differences were found for enjoyment of humor from reaction time and Likert scale data. In addition, females had higher scores in the Personal Distress subscale. From these results, we find an IRI subscale to correlate with an emotional hemispheric asymmetry model and questions arise in the variable speed of emotional processing for gender and ethnicity.

Individual and Hemispheric Differences in Affective and Humor Judgments

“Humor is emotional chaos remembered in tranquility.” James Thurber.

Humor is a universal quality innate to all human beings, so much so that babies can be born deaf and blind and still laugh appropriately (Provine, 2000). Yet it is vastly diverse, varying according to a person's cultural and linguistic background. It is an expression of one's unique identity and personality and at the same time can be used to enforce the norms of a society and indirectly exert control over the behavior of others (Long & Graesser, 1988). Humor is a topic that demands to be studied interdisciplinarily: what makes things funny, how humor is understood, how it is appreciated, and why we are compelled to share it. Humor has traditionally been discussed within philosophy and psychology, but with more observations coming by way of non-invasive brain imaging, humor is now being studied scientifically with the rigor of the laboratory. In the realm of psychology, the aspects of humor studied have been largely in the cognitive (humor detection) and affective (humor appreciation) domains.

The cognitive comprehension of humor in the realm of psychology has sided mainly with incongruity theory, which has its roots in the work of Aristotle's *Rhetoric* (trans. Kennedy, 1991) and Kant's *Critique of Judgment* (trans. Pluhar, 1987) as an expectation transformed. However, the processes that underlie humor detection or the exact elements of situation that need to be incongruous in order for it to be funny is a much disputed topic. One of the more popular incongruity theories is the detection and resolution theory (Goldstein & McGhee, 1972). According to this theory, the humorous moment starts with the detection of

an incongruity (e.g. a punch line) and proceeds to comprehension by comparing what was actually said to what was meant to be said or what is normally said. Intuitively, these processes would seem to come consecutively one after the other; however, Coulson and Kutas (2001) provided event-related potential (ERP) evidence that the detection and resolution stages to spotting an incongruity in a joke occur simultaneously. As mentioned, details regarding incongruity and humor are lacking. For example, which elements need to be incongruous in order for something to be funny is unknown, as is the importance of different media (written, visual, oral, tactile, static, dynamic), the role of context such as whether the context of the incongruity is threatening or non-threatening (Rothbart, 1976), extreme or bizarre (Berlyne, 1972), or made in a non-serious state-of-mind (Apter, 1982). Uekermann et al. (2007) also make the point that “incongruity resolution theory makes no reference to the need for general or social knowledge outside of the joke context” (p.558). Indeed, there are debates about whether incongruity even needs to be present in order for something to be funny (Shultz, 1972; Suls, 1972).

An interesting question is whether humor and the detection of incongruity in humorous stimuli parallels or is related to the propositional system of emotion proposed by the dual-memory model of emotion (Philippot & Schaefer, 2001). In this model, two emotional processing systems are proposed: a schematic system which is responsible for “hot”, autonomic responses that arise spontaneously when appraising a situation, and a propositional or “cold” system which is controlled by more executive functions and has the primary purpose of voluntary self-regulation of emotions (Schaefer, 2002). Although this model has not been formally applied to the domain of humor processing, hot and cold emotional processes may also underlie humor detection and appreciation. For example, the

ventromedial prefrontal cortex has been implicated in schematic processing and human adult emotional reactions (Bechara, as cited by Schaefer, 2002). This same brain region has also been implicated in the appreciation of jokes (Goel & Dolan, 2001). In addition, the lateral prefrontal cortex is thought to be important for executive functions underlying the propositional system (Schaefer, 2002) while the dorsolateral prefrontal cortex “has been implicated in executive functioning that may be crucial to examining, deconstructing, and understanding humorous stimuli” (Azim, 2005 p.16496).

Another interesting question regarding the relationships between humor, emotion and cognition is the effect of prior exposure on humor appreciation. To the author’s knowledge, no studies to date have studied this with humor stimuli; however, there is a rich body of research on prior exposure with regard to emotion processing, in particular, the effects of affective priming and habituation. The affective primacy hypothesis (Murphy & Zajonc, 1993) asserts that positive and negative affective reactions can be evoked with minimal stimulus input and virtually no cognitive processing. Wong and Root (1999) examined affective priming and found that there was a difference in emotional intensity reaction if the stimuli is presented unconsciously (17 ms) or consciously (1000ms) to the participant. If presented unconsciously, the strength of the effect decreases over time where as the priming effect remains consistent in strength if presented consciously. Related to this is the idea of affective habituation: subliminal exposure to extreme valence stimuli are rated as less extreme in subsequent measures. Studies using emotional picture and word stimuli have shown that the intensity of activity in the rostral anterior cingulate cortex decreases with affective habituation (Phan et. al., 2003; Dijksterhuis & Smith, 2002). Whether or not humor appreciation is primed or habituated with prior exposure has not yet been investigated.

Another outstanding issue question regarding the relationship between humor, cognition and emotion is whether there is a hemispheric advantage for humorous stimuli similar to that found for emotional stimuli. LeDoux and Gazzaniga (cited in LeDoux, 1996) studied split-brain patients and observed that even though a patient couldn't identify an object being shown in the left visual field, the person could still appraise its valence (LeDoux, 1996). Hemispheric asymmetry hypotheses regarding emotional processing fall into two main camps: 1) all emotions are processed by the right hemisphere, regardless of valence (e.g., Liotti & Tucker, 1992, 1994) or 2) positive emotions are processed by the left hemisphere, while negative emotions are processed by the right hemisphere (e.g., Davidson, 1984, 1987). Tucker and Liotti (1992, 1994) state that the right hemisphere is involved in emotional cognition, be it facial expression or prosody in linguistic material, or positive or negative valence. Davidson (1984, 1987) lateralizes emotion with approach behavior and positive emotions processed by the left hemisphere and withdrawal behavior and negative emotions processed by the right hemisphere. Emotions like fear and disgust would be included in behavioral components of withdrawal because fear usually accompanies it when a threat is detected. Recently, Sato and Aoki (2006) reported that the right hemisphere involved in the unconscious processing of negative emotions in a visual hemifield priming study.

With regard to hemispheric asymmetry in terms of humor, one theory comes from V.S. Ramachandran's work with anosognosia (a condition where patients deny paralysis of a certain limb following a stroke, 1996). His false alarm theory for humor holds that when facing an ambiguous event (he uses the example of the sounds of a potential burglar in the house), laughter serves as a signal to other members of the group that the perceived threat or anomaly is in fact unimportant (like if it turns out to be your cat knocking down a jar). He implicates the left

hemisphere as ignoring the potential threat until the right hemisphere forces a paradigm shift to activate the limbic system. Other lesion studies in humor show pathological laughter associated with right hemisphere lesions (Poeck, 1969; Rinn, 1984), humor appreciation debilitated by right frontal lesions (Shammi & Stuss, 1999), and left hemisphere damage patients seem to be impaired in incongruity detection (Bihrlle et al., 1986). Therefore, hemispheric asymmetries may also exist for humor processing.

Another issue is that other factors may also play an important role in humor, such as gender and ethnicity, or differences personality traits. Although gender and ethnicity have been studied extensively, and even though gender and ethnicity are common themes in humor (e.g., we love to hear the joke about the comedian's wife or the insane popularity of Dave Chappelle's brand of racial humor), very little has been studied in terms of the psychological differences between the consumers of such humor, let alone neurological differences. Azim et al. (2005) found that males and females appeared to recruit the same extensive humor-response strategies and had similar activations in temporal-occipital junction and temporal poles, females showed greater activation during humor comprehension in the left dorsolateral prefrontal cortex (showing more executive processing) and nucleus accumbens (for reward-network response). This would seem to imply that females use more cold-processing when it comes to thinking about and enjoying humor. While there have been studies in cross-cultural humor on Japan (Davis, 2006), Luso-Hispanic (Seaver, 2004), and the ethics of such kind of humor (Lockyer, 2005), the differences on a neurocognitive level have not yet been addressed. Studies at this level could inform to important social ideas about behaviors towards in and out-groups, cross-cultural theory of mind, and possibly even political decision making theories.

Individual differences in empathy (knowledge of the emotional states and feelings of others) and Theory of Mind (knowledge, thoughts, and beliefs a person infers that someone else is having) (Premack & Woodruff, 1978) may also play a role in humor comprehension. To date, Theory of Mind has been studied in the context of the study of schizophrenia and autism (Baron-Cohen et. al., 1985; Happe, 1994; Cocoran et. al., 1997; Marjoram et al., 2005), lesion studies (Shammi & Stuss, 1999), and aging studies (Uekermann, Channon, & Daum, 2006). To the author's knowledge, there are not studies directly examining empathy and humor. It would be worthwhile to explore because of derisive types of humor like satire and shadenfreude are enjoyed.

The objectives of the current study were fourfold: 1) to examine the putative role of "hot" and "cold" processes and their relationship to emotional processing and humor, 2) to investigate the effects of prior exposure on humor comprehension, 3) to elucidate the role of hemispheric asymmetry in affective and humor processing and 4) to uncover any relationships between individual differences in gender, ethnicity or empathy and humor processing. The overarching goal of this study was to better understand the relationships between humor, cognition and emotion and to provide a better theoretical understanding of humor comprehension that ties it to known theories of emotion processing.

"Hot" and "cold" processes were examined with two separate tasks. The first task was chosen to maximize reliance on rapid automatic processing and consisted of a forced choice valence task combined with visual hemifield stimulation. The second task was designed to maximize "cold", propositional processing and consisted of a humor ratings task, where participants viewed humorous photos and rated them for funniness. The combined use of

these tasks in different orders should enable the mutual influences of hot and cold processes on humor processing.

These same tasks were also used to examine the effects of prior exposure and the interplay between “hot” and “cold” processes. For some participants, the valence task (“hot” processing) was presented prior to the humor ratings task; whereas other participants completed the tasks in the opposite order. The rationale for this was to determine if prior exposure during the valence judgment task will have an effect (i.e., priming or habituation) on how funny a person sees the same pictures in the humor ratings task. Conversely, this design also could also be used to determine if prior exposure during the humor ratings task (“cold” processing) will have an effect on behavior in the valence task.

To the author’s knowledge, to date no studies examined the interplay between hot and cold processing and prior exposure with regard to humor; therefore, results are difficult to predict. One possibility is that hot and cold processes will be mutually influential. In other words, prior exposure in the valence task could increase or prime subsequent ratings in the humor ratings task. Similarly, prior exposure in the ratings tasks could affect valence judgments in the valence task. Another possibility is that the influence will be asymmetrical: hot processing may affect subsequent cold processing, but not the other way around. Alternatively, cold processing may only exert influence on hot processing. At present, it is unclear whether habituation or priming will be observed.

Hemispheric asymmetry was also examined in the valence task, which used visual hemifield presentation to selectively present images to the left or right hemispheres. According the hemispheric asymmetry hypothesis, images presented to the right visual field (RVF, left hemisphere) should be rated as more positive than those presented in the left

visual field (LVF, right hemisphere). These images may subsequently be rated as more humorous or less humorous due to affective priming or habituation, respectively. Conversely, images presented to the LVF should be rated as more negative than those presented to the RVF, with similar effects on subsequent exposure. However, if Liotti and Tucker's (1992, 1994) right hemisphere model of emotion holds for humorous stimuli, then no hemispheric asymmetries should be observed for the valence task, but there might be a LVF advantage (or disadvantage if habituation occurs) for stimuli during the humor ratings task.

A final objective of this study was to examine the role of individual differences in gender, ethnicity and empathy in emotional and humor processing. As mentioned, Azim et al. (2005) provided evidence that men and women might differ in terms of humor comprehension, with more activity in prefrontal regions associated with executive control, suggesting that "cold" processes might mediate humor comprehension more for men and women. Ethnicity may also play an important role in humor comprehension. One of humor's functions seems to be to produce "simultaneously a strong fellow-feeling among participants and joint aggressiveness against outsiders" (Lowe, 1986 p.440). While this could relate to many in/out group relationship (e.g. location or socio-economic status), ethnicity was the individual difference chosen for this study. It is of interest in the current study to see if valence and humor judgments are similar to others in their ethnic group even when a participant does these solitary tasks.

A final individual difference of interest was empathy. Differences in empathy are an important factor in humor appreciation because intuitively, the ability to understand and appreciate the feelings of others should help in the interpretation of ambiguous or incongruous social situations. The empathy measure chosen for this study was the Davis

Interpersonal Reactivity Index (1980). This measure was chosen because its subscales index both cognitive and emotional aspects of empathy. The IRI is composed of four subscales: perspective taking (PT), empathic concern (EC), fantasy (F), and personal distress (PD). It is predicted that empathy scores should be related to higher humor ratings, in particular the F and EC scales. Scores on the F subscale index the ability to feel for actors/protagonists in movies and books. Jabbi et al. (2007) show that areas in the anterior insula and adjacent frontal operculum on both hemispheres were highly correlated with the Fantasy subscale. It is hypothesized that EC scores will have a positive relationship with humor ratings because individuals scoring higher in EC have been reported to be more sensitive to violations of social norms (Blair & Curran, 1999; Parkinson, 2001), an important ability when it comes to more social theories of incongruity. The next prediction is that females will have higher PD scores than men as it has been reported that women are more prone to anxiety disorders than men (Seeman, 1997).

Methods

Subjects

Fifty healthy undergraduate volunteers (14 male, 36 female, 31 Caucasian, 2 African-American, 14 Hispanic, 1 Asian, 2 multiracial, and 37 Texas Natives) from Texas State University-San Marcos participated in the study. They were screened for psychotropic medication and normal or corrected-to-normal vision. They were compensated for their efforts by receiving extra credit for selected Psychology classes. Volunteers gave written informed consent for participation in the study. Procedures for human subjects were approved by the Institutional Review Board at Texas State University.

Stimuli

The stimuli used were humorous pictures (photos and cartoon drawings) that were normed by 54 participants on arousal value (calming/exciting), emotional valence (pleasant/unpleasant), and one question in how funny they saw each individual picture. Out of 114 original pictures, 60 of the funniest-rated pictures were chosen that were not outliers after standardizing for funniness, while controlling for arousal and valence. The stimuli were also edited to crop out any words present in the original pictures. The pictures were standardized in size (189 pixels in length) to show up as 5 cm on a 17-inch CRT monitor).

Empathy Questionnaire

Empathy was examined with the Interpersonal Reactivity Index (IRI) (Davis 1980). The IRI is composed of four seven-item subscales: perspective taking (PT), empathic concern (EC), fantasy (F), and personal distress (PD). The PT subscale measures the tendency to adopt another's point of view (e.g., "I sometimes try to understand my friends better by imagining how things look from their perspective."). The EC subscale measures feelings of sympathy and concern for others (e.g., "I often have tender, concerned feelings for people less fortunate than me."). The F subscale measures the ability to imagine oneself in the role of a fictitious character in books (e.g., "When I am reading an interesting story or novel, I imagine how *I* would feel if the events in the story were happening to me."). The PD subscale measures personal feelings of anxiety and unease in interpersonal settings (e.g., "Being in a tense emotional situation scares me."). The alpha coefficients for internal reliability for this scale have been reported to range from .70 to .78 and for test-retest reliability ranges from .61 to .81 for the scale (Davis, 1996).

Experimental design and Procedure

After signing the consent form and answering the background questions, participants were either asked to fill out the Interpersonal Reactivity Index (IRI) or complete the computer tasks. Task order was fully counterbalanced across subjects. For both tasks, the subjects were seated with their heads supported by a chin-and-forehead rest placed approximately .57 m from the monitor. The events were controlled by Superlab 2.0 stimulus presentation software and presented on a 17 inch CRT monitor.

In the valence task (Figure 1), the subject made a forced-choice between a positive or negative emotional rating for 60 pictures that were presented in the right or left visual fields. The pictures fell into four categories depending on the combination of normed valence (positive or negative) and visual field presentation (left or right). Visual stimuli displayed with the inside edge of the picture 9.5 cm left or right of the center. Left and right hemifield presentation of the different stimuli was counterbalanced across subjects. For each picture sequence, there was first a fixation point 500ms and then the picture was displayed for 40ms. The fixation cross appeared immediately afterwards and the participant had to a forced-choice valence judgment (positive or negative). Keypresses were also counterbalanced across subjects. All reaction times above 1000ms (timed-out trials) were eliminated and participant was discarded if there were more than 5 timed out trials in any of the four trial categories mentioned above. The proportion of positive and negative responses was then calculated for each trial type. Means were used as a measure of central tendency for reaction times.

For each trial of the humor condition (Figure 2), the same 60 pictures shown in the valence task were displayed in the center of the screen for an unlimited time period, preceded

by a fixation cross that appeared for 500ms. The subjects rated each picture for funniness on a nine-point scale (1 = not funny at all, 5 = sort of funny, 9 = extremely funny). The picture remained in the center of the screen until a rating was made. For any picture that was in a trial discarded from the valence task, the corresponding trial was also removed from the humor task. Medians were used as a measure of central tendency for the humor reaction times because of the unlimited time limit for viewing pictures in this task. Therefore, the median was considered a more robust measure for central tendency.

For the IRI, participants answered the scale questions using a scantron form. Participants answered on a five point Likert scale (one indicating “not like me” and five indicating “very much like me”). Subscale scores were determined by reverse-scoring the appropriate items and summing across the questions associated with each IRI subscale (PT, EC, F, PD).

Behavioral Data Analysis

Data were analyzed with SPSS 16. For the valence data valence ratings and mean reaction times were examined using Repeated-Measures ANOVAs with visual field presentation (right, left) as a within subjects variable. The between subjects factors were task order (valence vs. ratings task), gender (male, female), and ethnicity (Caucasian, non-Caucasian). For the ratings task data, humor ratings and median reaction times were examined using Repeated-Measures ANOVAs with visual field presentation in the valence task (right, left) as a within subjects variable. The between subjects factors were task order (valence vs. ratings task), gender (male, female), and ethnicity (white, nonwhite). For these analyses, ethnicity was collapsed into a Caucasian and a non-Caucasian category. For statistically significant ($p < .05$) results, we then checked for effect size using partial-eta-

squared and anywhere appropriate, Bonferroni-corrected pair-wise or independent t-tests were conducted on significant effect or interactions.

Questionnaire Data Analysis

With IRI subscales and gender as predictors, four separate linear regressions were conducted on 1) reaction times for the valence task, 2) proportion of negative responses in the valence task, 3) humor ratings in the ratings task and 4) viewing times in the ratings task.

Results

Valence Reaction Times

Repeated Measures ANOVA on valence judgment reaction times with visual field as a within subject variable and task order, gender and ethnicity as between subjects variables revealed an interaction between task order and gender, $F(1, 42) = 5.837, p < .05$, partial $\eta^2 = .082$ (Figure 3). After follow-up post hoc *t*-tests, this interaction was due to the fact that when the valence task was first, there was marginal significant difference for LVF reaction time, $t(22) = 2.232, p = .052$, and significant difference for the RVF reaction time, $t(22) = 3.258, p < .01$. These results suggest that the interaction was due to the difference between gender differences when the valence condition is first. Males on average took longer for each trial. No significant relationships were found between IRI and valence reaction time in the linear regression

Proportion of Valence Responses

Repeated Measures ANOVA on the proportion of negative responses with visual field as a within subject variable and task order, gender and ethnicity as between subjects variables revealed no significant results ($F < 1$) for comparisons between valence reaction times, humor reaction times, and humor responses. Linear regression (Table 1) found a significant

negative correlation between the fantasy subscale and right visual field (left-hemisphere) proportion of negative ratings ($\beta = -.317$, $t = -2.316$, $p < .05$). Linear regression also found marginal positive correlation between the Fantasy subscale and left visual field (right-hemisphere) proportion of negative ratings ($\beta = .263$, $t = 1.886$, $p = .065$). The higher Fantasy subscale scores were associated with an increased proportion of negative ratings if pictures were presented in the left-visual field. In contrast, higher Fantasy scores were associated with a decreased proportion of negative responses (and more positive responses) when pictures were presented in the right visual field.

Humor Viewing Times

Repeated Measures ANOVA on humor task viewing times with visual field as a within subject variable and task order, gender and ethnicity as between subjects variables revealed a between subjects interaction between gender and ethnicity: $F(1,42) = 4.24$, $p < .05$, partial $\eta^2 = .092$ (Figure 4). After follow-up post hoc t -tests, we find a main effect for gender where men looked longer at the humor pictures than women did; $F(1,46) = 4.631$, $p < .05$, partial $\eta^2 = .091$. We also found a significant difference in that Caucasian men viewed humor stimuli longer (median average time: 3557 ms) than Caucasian women (median average time: 2418 ms) no matter which visual field shown during the valence condition (right $t(7.499) = 2.948$, $p < .05$; left $t(8.303) = 2.306$, $p < .05$). Caucasian men also viewed humor stimuli longer than non-Caucasian men (median average time: 2467ms) for when the picture was presented in the right visual field in the valence condition, $t(9.523) = 2.624$, $p < .05$. These differences are regardless of task order.

Humor Ratings

Repeated Measures ANOVA on valence humor ratings with visual field as a within subject variable and task order, gender and ethnicity as between subjects variables revealed a task order and visual field within-subjects effect, $F(1,46) = 4.828$, $p < .05$, partial $\eta^2 = .095$ (Figure 5). After some pair-wise t-tests split across task order and then visual field, the only significant difference that appears to be driving this interaction is the difference in humor ratings between where the stimulus was presented in the valence task when the humor condition is *first*. Pictures presented on the left visual field (right hemisphere) during the valence condition were seen to be funnier when the humor condition was first, $t(25) = 2.339$, $p < .05$.

The Repeated Measures ANOVA also found a main effect on gender ($F(1,46) = 5.040$, $p < .05$, partial $\eta^2 = .099$) and a main effect on ethnicity ($F(1,42) = 5.183$, $p < .05$, partial $\eta^2 = .110$) but no interaction between them ($p > .05$). Men seem to have found the stimuli funnier (average rating of 4.414 vs. 3.696) as did non-Caucasians (average rating of 4.455 vs. 3.739).

Further IRI Analyses

In order to determine whether there were gender and ethnicity differences in IRI scores, an additional independent t-test was conducted with subscale scores as within-subjects variables and gender and ethnicity as between subjects variables. This analysis revealed a significant gender difference in Personal Distress scores and Gender ($t(48) = -4.334$, $p < .001$). Women had higher levels of Personal Distress relative to men (mean score of 19.3 vs. 14.8). No correlations between any reaction times and condition responses.

Discussion

The objectives of this study were to examine the putative role of “hot” and “cold” processes and their relationship to emotional processing and humor, to investigate the effects of prior exposure on humor comprehension, to elucidate the role of hemispheric asymmetry in affective and humor processing and to uncover any relationships between individual differences in gender, ethnicity or empathy and humor processing. While there was no specific hypotheses for hot and cold emotional processes would affect humor processing, these constructs underlie the methodological choices made for the current study regarding the prior exposure and visual.

In regards to prior exposure, the results suggest that cold processing may only exert influence on hot processing and prior exposure in the ratings tasks could affect valence judgments in the valence task. This is suggested by a task order by hemisphere within-subjects effect with humor ratings. When the valence task was done first, there were no differences between humor ratings as a function of hemisphere. However, when the humor task was done first, pictures that were subsequently presented to the RVF (left hemisphere) in the valence condition were rated as less funny relative to those that were subsequently presented to the LVF. One interpretation is that prior exposure to the left hemisphere may have increased the perceived funniness of these pictures, consistent with the idea that the left hemisphere is associated with approach behaviors (Davidson, 1984, 1987). This would support that cold processes could affect subsequent hot processing by prior exposure. However, given the relatively small sample size in this experiment, replication of these results would be necessary.

With regard to hemispheric asymmetry in emotions, the results suggest some hemispheric asymmetry of valence judgments, but only for individuals who scored highly on the Fantasy IRI subscale. The fact that higher Fantasy subscale scores were associated with an increased proportion of negative ratings if pictures were presented to the left-visual field (right hemisphere) and with a decreased proportion of negative responses (and more positive responses) when pictures were presented in the right-visual field (left hemisphere) is congruent with the hemispheric asymmetry hypothesis.

We did see individual differences in gender, ethnicity, and empathy. Gender and ethnicity were seen to be predictors for reaction time in the valence task, humor reaction time, and humor ratings. When the valence task was administered first, the result was as predicted: men seemed to take longer than women in making a valence judgment. This result could have occurred for at least two reasons. First, men's judgments may rely more on cold processes, or less on hot processes, than women. This explanation is not supported by Azim (2005) study whose data suggest that women seemed to exhibit more executive functioning than men did. Alternatively, the stimuli may have been more salient to men, resulting in greater attentional capture, slower disengagement of attention and consequently, slower reaction times. Further research is necessary to fully understand this result.

This discussion is also germane to the observation that men viewed the humor stimuli longer than the women did for the humor ratings task that was meant to elicit more cold processes. Ethnicity could also be a factor since white males viewed the pictures almost a second longer than any other group. Gender and ethnicity differences were also observed in humor judgments, with men finding the pictures funnier than women and non-Caucasians finding them funnier than Caucasians. This may point to these groups as gathering more

enjoyment from visual pictures or cartoons. Another avenue for study is further exploring gender differences in hot processes and cold processes. However, results with gender and ethnicity must be interpreted with caution, since only 28% of the total participants were males and only 38% of participants were non-Caucasians.

With regard to individual differences in empathy, as mentioned above, visual hemifield presentation affected valence judgments in a manner congruent with the hemispheric asymmetry hypothesis (Davidson, 1984, 1987), but only for individuals who scored highly on the Fantasy subscale. Significant relationships with behavioral variables and the EC subscale were not seen as was predicted. This result seems inconsistent with the notion that individuals high in EC are sensitive to violations in social norms (Blair & Curran, 1999; Parkinson, 2001) and since violations of expectations or norms are central to incongruity theories of humor (Goldstein & McGhee, 1972). However, this result may have occurred with as visual stimuli, the pictures used for this study were not specifically chosen for being socially incongruous. It was also predicted and confirmed that women would have higher scores for the PD subscale of the IRI. Because the PD scale is highly related to anxiety (Davis, 1983), this result mirrors the results of several studies that suggest that women are more anxious than men (Seeman, 1997) and could tie back to the previously stated hypothesis that women may rely more on hot processes when making valence and humor judgments relative to men.

One of the limitations for the study was that the norming process had ratings occurring with groups of people (between 2-10 at a time) and the experiment had one person rating these items alone in the room. This change of social context may have confounded the experiment. The next time the study is conducted, one person will rate the pictures at a time

in the norming process. There may also be issues in the methodology who claim humor as a social phenomenon and these one-person experiments are taking humor out of its proper context, but for the sake of studying hemispheric, this will have to be sacrificed.

Another priority is to increase the statistical power by evening out the genders and the ethnicities. It is not necessarily fair to collapse all those ethnicities with their unique histories, culture, and sense of humor into one category. It is also culturally competent to compare them as being closer to the same and saying that the Caucasian culture is something fundamentally different than the rest. Both of these problems will be addressed the next time this experiment is performed.

The humor rating task would be changed if this study would be done again. The nine-point Likert scale for the humor ratings may have not been the best measure in regards to the possible range of the participants answers. One person may have used every number rating at least once in rating while someone else may have alternated between two numbers. The new humor rating condition would be a hemifield presentation with pictures displayed for 1500ms on one visual field and have a forced-choice between funny or not-funny (Figure 6). This will make both conditions more comparable. There should also be longer practice sessions with the computer tasks so they don't go in unprepared. The experiment including the IRI took on average about 15 minutes for each participant so we are not worried about this slight extension.

One potential issue is that in the valence task, although pictures were presented to the left and right visual fields, selective presentation to each hemisphere can only occur if the eyes are fixated straight ahead. It is possible that, in spite of the short presentation time of the pictures and the use of a chinrest, eye movements occurred during the valence task, and both

hemispheres were stimulated rather than just one. Future studies employing eye tracking technology will need to be conducted to make absolutely sure that the participants are centrally fixating and those stimuli are being presented selectively to one hemisphere or the other.

As stated throughout this discussion, there are plans to conducting this experiment again with the specified changes. In addition, other factors affecting humor will also be examined. For example, one experiment would be to study the effects of posture on humor appreciation and examine the differences in enjoyment of humor between a group that is standing up, sitting down, or lying down. This would be a behavioral study that may have implications for functional magnetic resonance imaging studies of humor that are singular and usually lying down. Another study would be to examine the effects of social factors in humor appreciation, to look at the difference between humor appreciation when someone rates the stimuli while alone, or in the presence of others. Another fruitful area of inquiry would be to conduct an event-related potential study on the relation of magnitude of the late positive potential (a central positivity that occurs approximately 500 ms after stimulus presentation) and humor ratings. There is also an interest in finding possible animal models that could be used to study humor/feeling of mirth on a comparable level to human beings. The possible animal models would be rats, squirrel monkeys, chimps, and human controls and they would be tickled in certain areas in a functional magnetic resonance imaging machine. This will help further the physiological and evolutionary studies of humor. Results from these studies mentioned may spell the return of this study on emotional and humor judgments that could have results to test with functional magnetic resonance imaging or near infrared spectroscopy and then transcranial magnetic stimulation.

Conclusions

The overarching goal of this study was to better understand the relationships between humor, cognition and emotion and to provide a better theoretical understanding of humor comprehension that ties it to known theories of emotion processing. While this goal cannot be fully answered from the scope of this experiment, there were results to help lay a foundation for future work. There was support for cold emotion processing affecting hot emotional processing. There were also results suggesting how individual differences play a role in the reaction time for valence and humor judgments and different components of empathy. There is still work to be done on humor judgments and more questions to be answered in its relation to emotion and cognition. This research was just a starting point for future work on the subject.

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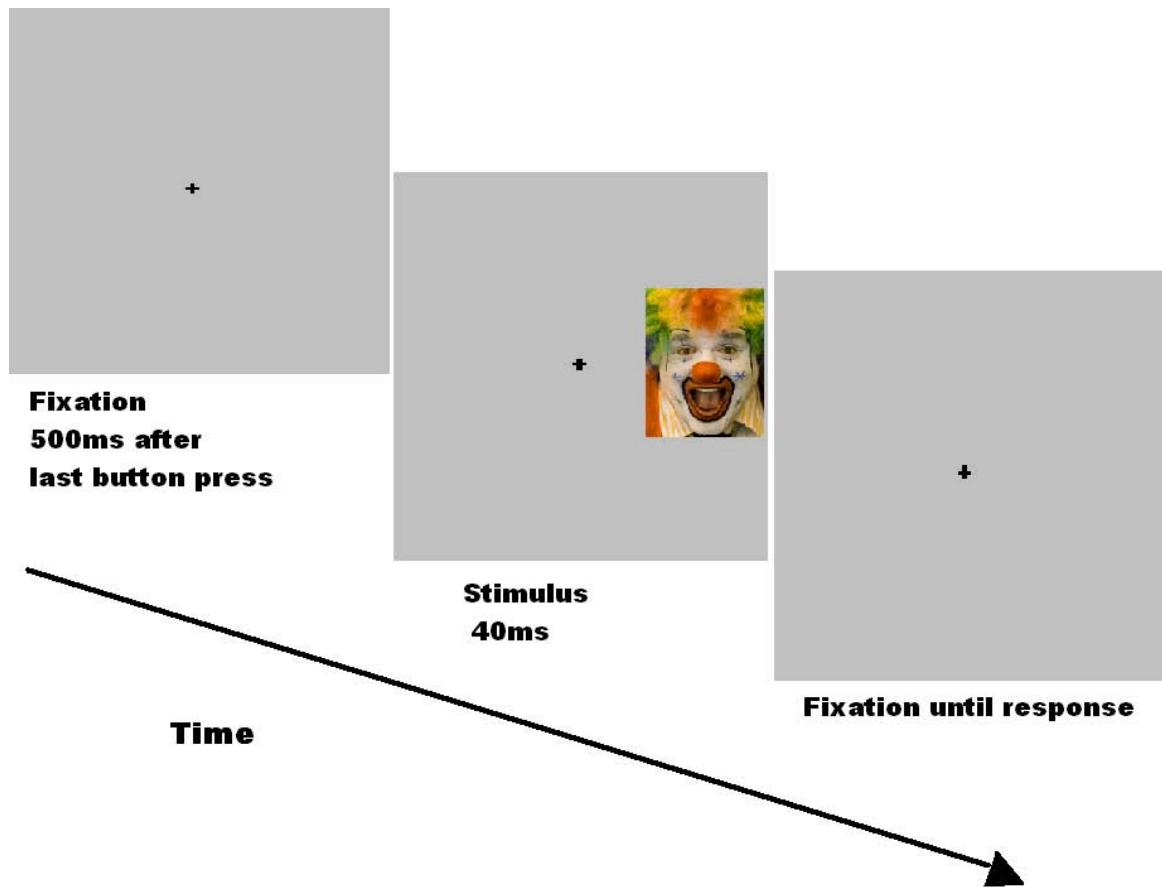


Figure 1. Example of the stimulus sequence in a trial of the two-alternative forced choice valence task.

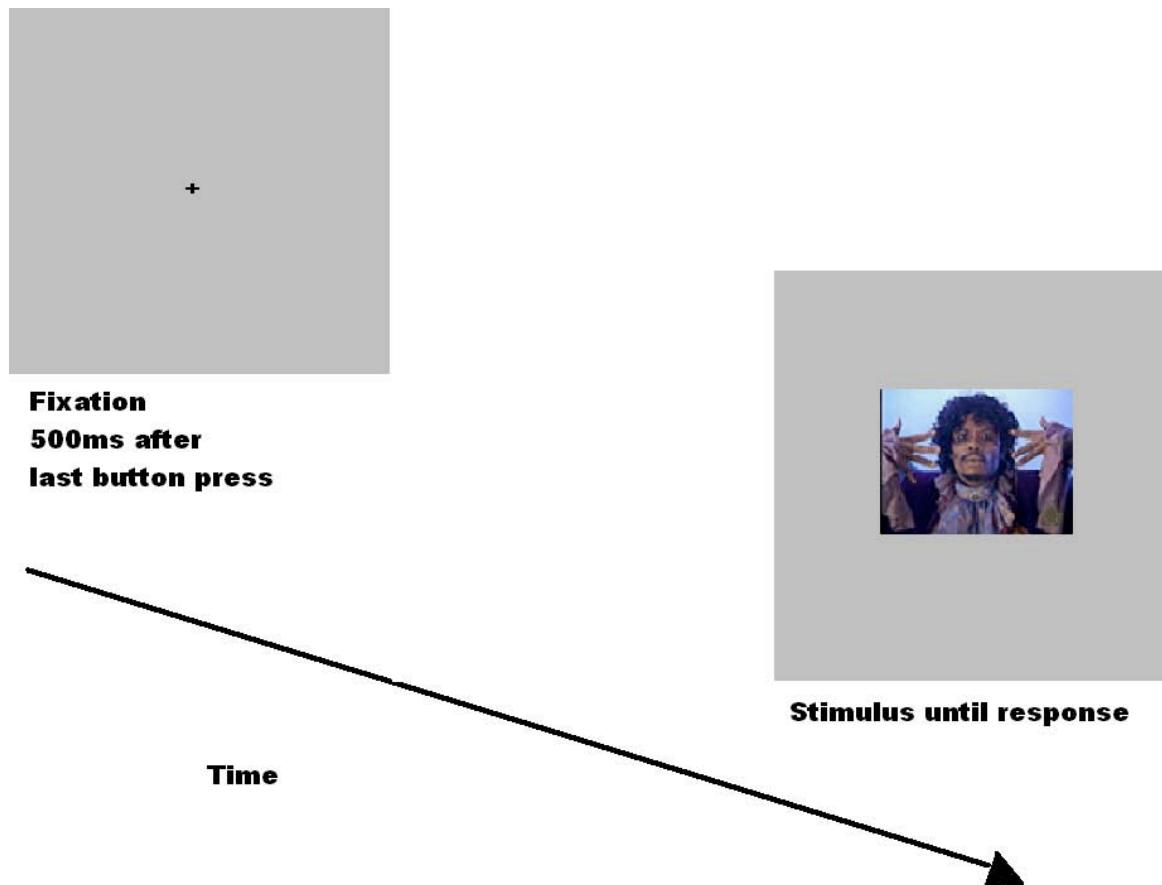


Figure 2. Example of the stimulus sequence in a trial of humor judgment task.

Table 1:

Standardized beta values for IRI subscores and proportion of negative ratings by visual field of presentation.

Subscale	Left V.F. Negative Ratings	Right V.F. Negative Ratings
Perspective Taking	--	--
Personal Distress	--	--
Fantasy	.317*	-.319*
Empathic Concern	--	--

* $p < .05$; -- $p > .05$

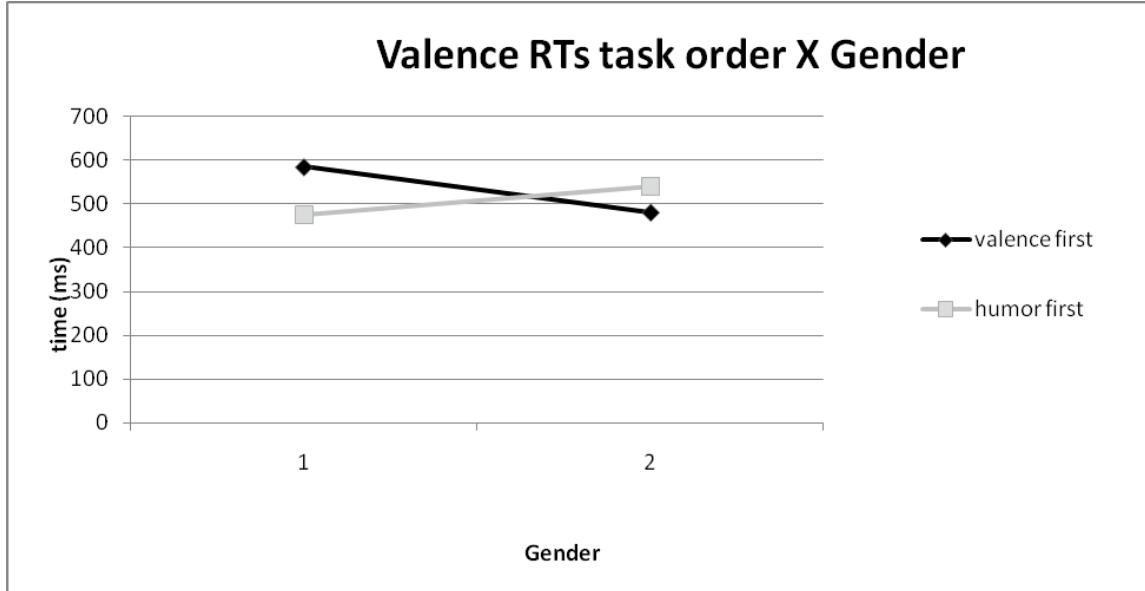


Figure 3: *Valence Reaction Times interaction between task order and gender.* The interaction is mainly driven by the difference between gender differences when the valence condition is first. Gender 1 is male and gender 2 is female.

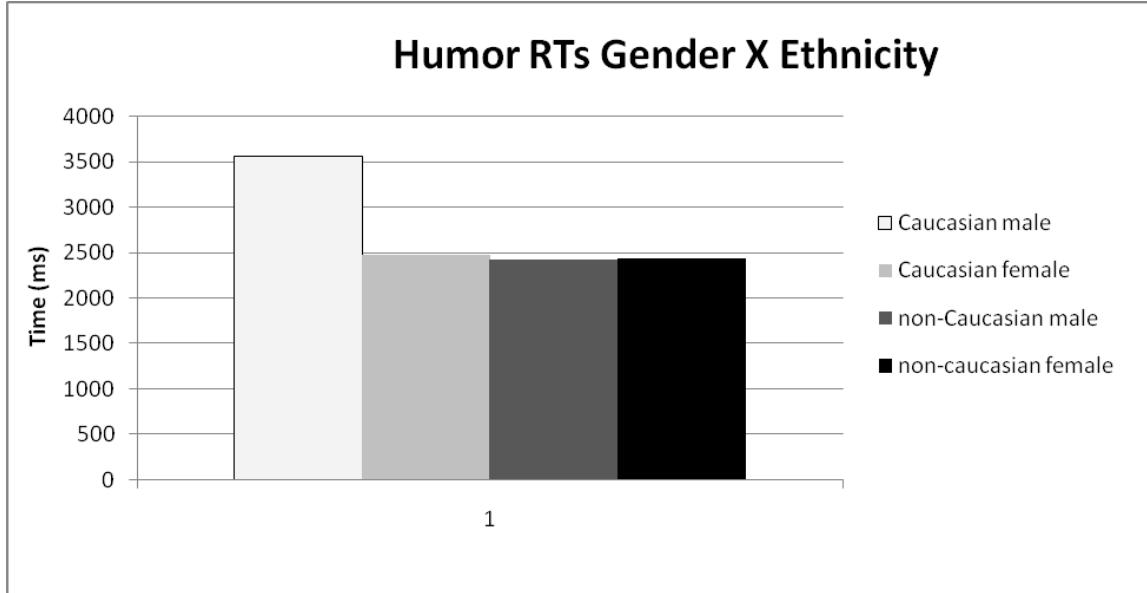


Figure 4: *Humor Reaction Times Gender and Ethnicity Interaction*. Caucasian men viewed humor stimuli longer than Caucasian women no matter which visual field shown during the valence condition. Caucasian men also viewed humor stimuli longer than non-Caucasian men for when the picture was presented in the right visual field in the valence condition.

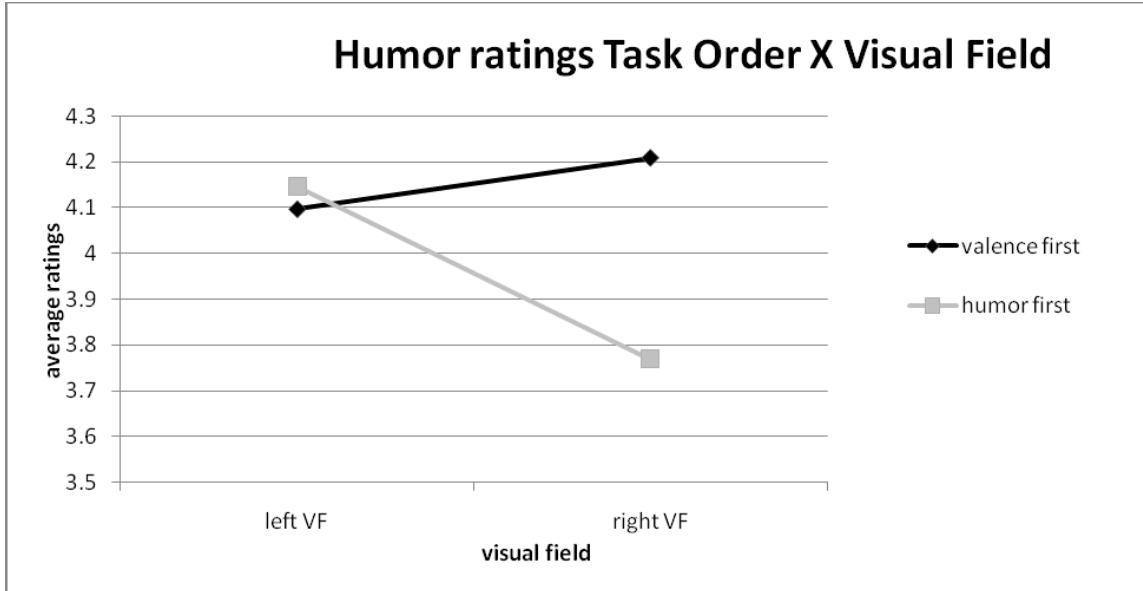


Figure 5: *Humor ratings Within subjects interaction between task order and visual field.*

Pictures presented on the left visual field (right hemisphere) during the valence condition were seen to be funnier when the humor condition was first.

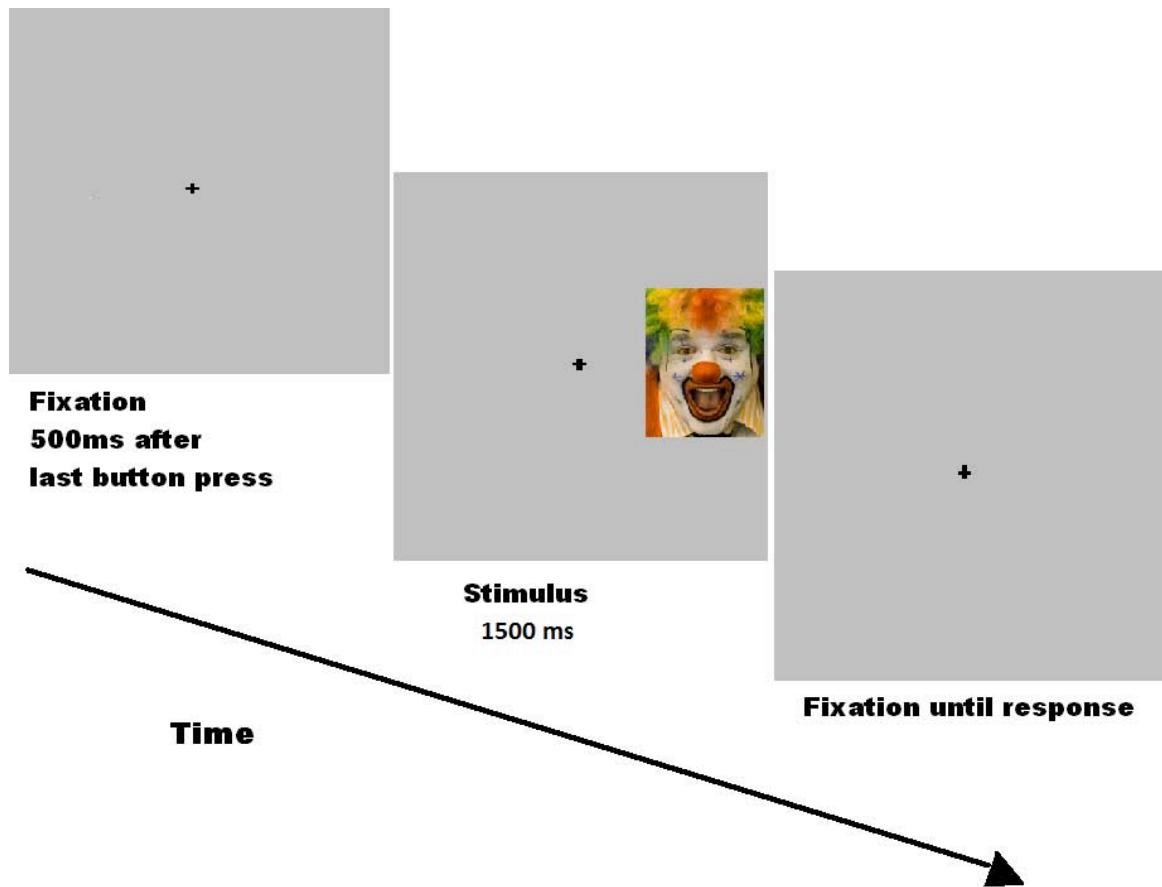


Figure 6: *Proposed new Humor Judgment task.*

APPENDIX
Interpersonal Reactivity Index

Items 4 to 40. The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you on a scale of A (not at all like you) to E (very much like you).

1. I daydream and fantasize, with some regularity about things that might happen to me.

A	B	C	D	E
Not like me				Very much like me

2. I often have tender, concerned feelings for people less fortunate than me.

A	B	C	D	E
Not like me				Very much like me

3. I sometimes find it difficult to see things from the “other guy’s” point of view.

A	B	C	D	E
Not like me				Very much like me

4. Sometimes I don’t feel very sorry for other people when they are having problems.

A	B	C	D	E
Not like me				Very much like me

5. I really get involved with the feelings of the characters in a novel.

A	B	C	D	E
Not like me				Very much like me

6. In emergency situations, I feel apprehensive and ill-at-ease.

A	B	C	D	E
Not like me				Very much like me

7. I am usually objective when I watch a movie or a play, and I don’t often get completely caught up in it.

A	B	C	D	E
Not like me				Very much like me

8. I try to look at everybody's side of a disagreement before I make a decision.

A	B	C	D	E
Not like me				Very much like me

9. When I see someone being taken advantage of, I feel kind of protective towards them.

A	B	C	D	E
Not like me				Very much like me

10. I sometimes feel helpless when I am in the middle of a very emotional situation.

A	B	C	D	E
Not like me				Very much like me

11. I sometimes try to understand my friends better by imagining how things look from their perspective.

A	B	C	D	E
Not like me				Very much like me

12. Becoming extremely involved in a good book or movie is somewhat rare for me.

A	B	C	D	E
Not like me				Very much like me

13. When I see someone get hurt, I tend to remain calm.

A	B	C	D	E
Not like me				Very much like me

14. Other people's misfortunes do not usually disturb me a great deal.

A	B	C	D	E
Not like me				Very much like me

15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

A	B	C	D	E
Not like me				Very much like me

16. After seeing a play or a movie, I have felt as though I were one of the characters.

A	B	C	D	E
Not like me				Very much like me

17. Being in a tense emotional situation scares me.

A	B	C	D	E
Not like me				Very much like me

18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.

A	B	C	D	E
Not like me				Very much like me

19. I am usually pretty effective at dealing with emergencies.

A	B	C	D	E
Not like me				Very much like me

20. I am often quite touched by things that I see happen.

A	B	C	D	E
Not like me				Very much like me

21. I believe that there are two sides to every question and try to look at them both.

A	B	C	D	E
Not like me				Very much like me

22. I would describe myself as a pretty soft-hearted person.

A	B	C	D	E
Not like me				Very much like me

23. When I watch a good movie, I can very easily put myself in the place of a leading actor.

A	B	C	D	E
Not like me				Very much like me

24. I tend to lose control during emergencies.

A	B	C	D	E
Not like me				Very much like me

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while.

A	B	C	D	E
Not like me				Very much like me

26. When I am reading an interesting story, I imagine how *I* would feel if the events in the story were happening to me.

A	B	C	D	E
Not like me				Very much like me

27. When I see someone who badly needs help in an emergency, I go to pieces.

A	B	C	D	E
Not like me				Very much like me

28. Before criticizing somebody, I try to imagine how I would feel if *I* were in their place.

A	B	C	D	E
Not like me				Very much like me