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Images of emotion versus emotion words (English)

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Note: this was originally written in 2006 and revised in both 2010 and 2012; original web presentation version of project posted at http://www.galileoco.com/surveyPortal/emotion/imgWrd06projectWeb.htm Preliminary work for follow-up project is at http://www.galileoco.com/surveyPortal/emotion/emotion2011.htm .

Abstract

Spatial representations of pair comparison data on participants' perception of emotion words and pictures of a person displaying those emotions were examined; it was found that both image and word response coordinates arrayed in a similar spatial manner. This could be useful in marketing situations if it generalizes to other image and word pairs, for example logos and company names. Use of two different criterion pairs was also examined. Responses using the two pairs tested appeared to result in equivalent spatial arrangement of the response coordinates but each using a different scale.

Key Words: Emotion, Words, Images, Pair Comparison Measurement, Spatial Modeling, Galileo.

Images of Emotion vs. Emotion Words

The purpose of this study was to inspect spatial analysis of results from two surveys examining how people perceive emotion words (e.g., "happy," "sad," etc.) and pictures of a person displaying those emotions. The idea of relating verbal communication (whether spoken or written) and nonverbal communication is not new. Darwin in the late 1800s was the first to systematically study facial expressions (Frank, 2003). He proposed that emotions were displayed in the same manner by people in all cultures (Darwin, 1898). Much of the research after Darwin, however, did not support his idea of universal emotions. It has been suggested that this subsequent disagreement may, at least in part, have been due to the fact that researchers were using a plethora of emotion words, some of which were largely synonymous (for example "rage," "anger," and "fury") (Frank, 2003).

Paul Ekman resurrected Darwin's idea of universality by proposing a theory regarding cultural display rules to explain why it sometimes appeared that people in different cultures display the same emotion differently (Ekman, 1999; Harper, Wiens, & Mattarazzo, 1978). He notes that words are but representations of emotions, not the emotions themselves (Ekman, 2004, p. 199). This fits well with communication semiotic theory which states that verbal signs (words) are similar to, but not the same as, what they represent (Ellis, 1992) in the way that photographs refer to, but are not equated with, the reality they depict (Littlejohn, 1999; Noth, 1990).

Forced Choice Identification

Ekman stated, in a 1994 unpublished manuscript quoted in Ekman & Rosenberg (1995), that words and facial expressions each refer to something the other does not. That concerned Russell, especially in regards to the forced-choice identification format used in many studies of emotion (Russell, 1993); he felt sometimes people may agree on the same incorrect answers

when only provided with a small list of emotion words in response to a picture. Izard's work, however, indicated that a forced-choice format was an acceptable method (1994); the use of this method was also supported by Ekman & Rosenberg's 1995 work as well as Haidt & Keltner's work in 1999.

Whether or not categorical perception of facial expressions exists remains a continuing research concern related to the idea of forced-choice response. Alvarado's work using multidimensional scaling with facial expressions and the labeling of those expressions not only countered Russell's concerns regarding forced-choice identification but also suggested that emotion perception may be categorical, rather than dimensional (Alvarado, 1996). Work with neural networks done by Cottrell and Padgett took that a step further by concluding that categorical perception is the result of learning (Padgett, 1998; Padgett & Cottrell, 1998). More recent work using event-related potentials also suggests that categorical perception may be learned and Damasio et al. (2004) suggest there is not one single system supporting word retrieval but several systems. Posner also feels recent studies regarding cognitive tasks suggest a network of operations (Posner, 2004). This has implications for the debate as to whether images or words prompt preferential cognitive processing—and relates to this study because one of the research aims was to observe whether responses prompted by words differed from those prompted by images.

The primary concern of this exploratory research was with the spatial placement of concepts in relation to one another and the generally accepted six basic emotions noted by Ekman (anger, disgust, fear, happy, sad, surprise) were used in this study. Those six emotion words have also been used in at least one similar study comparing facial expressions and

emotion words spatially, although it should be noted that Brandt & Barnett (1979) actually used seven emotion concepts, these six plus “interest-excitement”.

Methods

Participants were 355 undergraduate students in three sections of an introductory communication course taught at a large northeastern university. Students were randomly assigned to complete one of four possible pen and paper surveys (Appendices A, B, C, D).

These surveys used paired comparison measurement; that is, each survey asked participants to assign a numeric value to the difference perceived between the concepts in each object pair (concepts were either words or images). Since every concept is usually paired with every other concept in this type of survey, the total number of concept pair questions asked depends on how many concepts are being considered. In this study seven concepts were considered so each participant was asked twenty-one pair comparison questions. The word surveys asked participants to compare the six words referring Ekman’s as emotions (anger, disgust, fear, happy, sad, surprise) plus the word "yourself" and the image surveys asked participants to compare images showing facial expressions of those emotions plus the word “yourself.”

Choice of Criterion Pair

In addition to considering the concepts as either images or words, half the surveys used an alternate criterion pair: “anger and sad are 100 units apart,” rather than “happy and sad are 100 units apart”. A criterion pair may be thought of as an example concept pair to be used when considering all other concept pairs, thus providing participants with an idea of scale for the numeric values they choose.

One consideration in choosing a criterion pair is the numeric scale value. The actual value of the numeric scale chosen appears to be largely irrelevant; what matters is establishing the relative distances of each from the others. Gordon found that varying how far the concepts in the criterion pair were from each other did not affect relative distances assigned between the other concepts being investigated (1976); those distances merely increased or decreased in relation to the criterion pair specified. In the present study, one-hundred units was chosen as the numeric scale value. That value was considered appropriate for Americans familiar with percentages and a currency with one-hundred pennies in a dollar. This was in keeping with the stricture that "…our efforts to introduce standards of measure must fit within the set of standards already in use" (Woelfel & Fink, 1980).

Another consideration regarding criterion pair choice is that opposite concepts have been found to exhibit effects similar to using criterion pair concepts from a different domain than the one being studied ("domain" indicates a set of concepts that are related in some manner) (Gordon, 1976; Gordon & DeLeo, 1976). Woelfel and Fink later reiterate this point in their 1980 book, indicating that to minimize error a criterion pair that is neither the largest nor the smallest concept pair in the domain being studied is the most useful.

A final consideration when choosing criterion pair concepts, as stated by Woelfel & Fink, is that: "It is well to choose as a standard unit the distance between two points that most members of the culture would themselves consider to be relatively invariant…" (1980, p. 68). That is, it is best if most members of a participant's cultural group regard the distance between the two concepts chosen for the criterion pair as unlikely to change. Although Brandt & Barnett (1979) successfully used "'surprise' and 'fear' are 10 centimeters apart" as their criterion pair (they specified a physical distance measure as their survey involved participants indicating points

along a meter stick to specify concept distance), that criterion pair should not be used in this study as it was felt the response value (location) for "surprise" might be likely to differ amongst respondents. Instead, this study tested use of a fairly large, but not opposite, concept pair ("happy and sad are 100 units apart") against a relatively small, "close", concept pair ("anger and sad are 100 units apart").

Response Evaluation

Three hundred and fifty one survey responses were evaluated; responses from one survey were not entered as the participant wrote the words "less" and "more", rather than providing numeric values. Another excluded survey included a number of unusual values, the most memorable of which were √25 and the word "pudding". The final two excluded surveys had more blank responses than answers. Additional survey response details and totals are in Appendix E.

All response values were transferred from the paper surveys into the computer using SPED and evaluated using MICROGAL, INTERGAL\V56, and ALLSPLIT (programs in the Galileo™ software suite, http://www.galileoco.com). V56 aggregate coordinate file output was separated into individual result sets using breaker1.py, a python program developed by Dr. Hao Chen and very slightly modified by the author (note: breaker1.py isn't necessary to separate this type of output but it is especially useful when keeping track of multiple set rotations). Charts and graphs were constructed by cutting portions of the reports generated by the Galileo software and using the "text to columns" function when pasting them into Microsoft Excel. Tables were all originally created in Microsoft Excel and then copied into Microsoft Word; table format was then often slightly modified to ensure page fit (with the exception of Appendix F which was created in Excel, pasted into Macromedia Fireworks, saved as a .gif file, and then inserted into Microsoft Word).

Coordinate representations are screenshots of data coordinate files viewed using the program Thoughtview (TV32).

Results

The main finding is that image responses and word responses do array in a similar spatial manner for the six emotions considered, as shown in rotated 3D and 2D combination images (Figures 1 & 2).

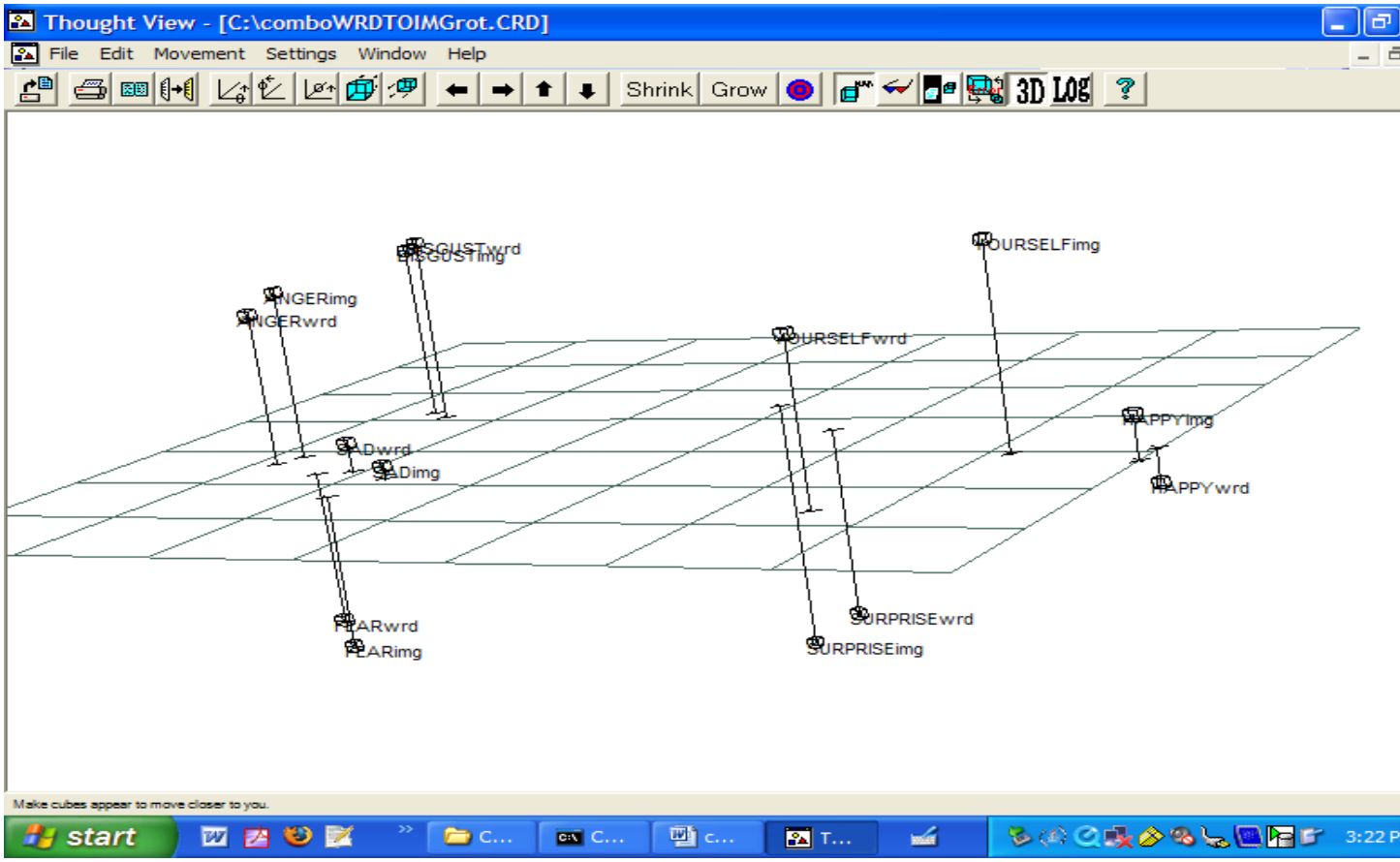

Figure 1: Word responses and image responses, 3D combination plot

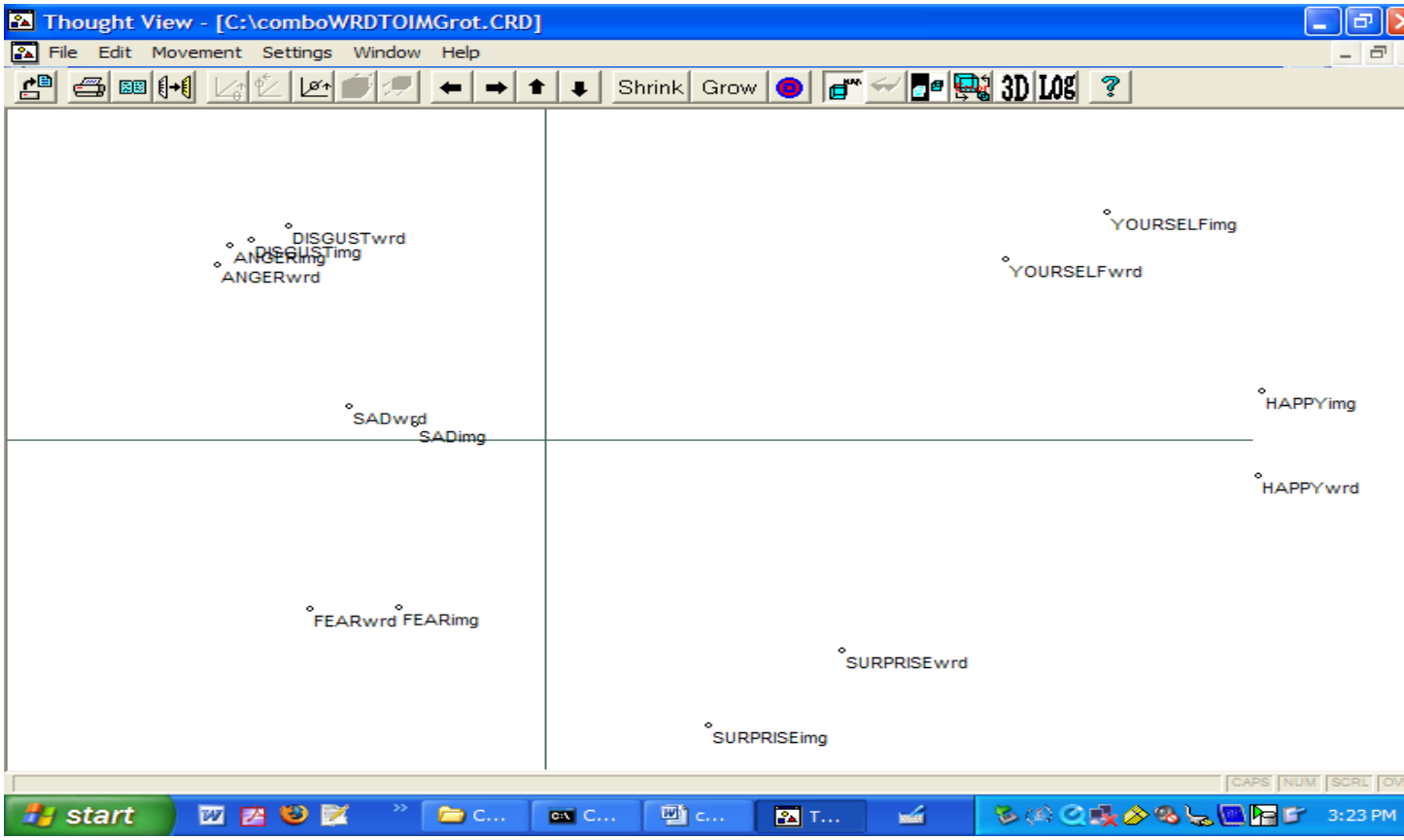

Figure 2: Word responses and image responses, 2D combination plot

Although no clear pattern of differences between the spaces emerged for the image and word responses, angerSad pair responses appear to have been consistently answered using a larger scale than happySad pair responses. This can be seen as all the response means for the angerSad pairs are larger than the response means for the happySad pairs (Appendices H-3 & H4) and the plotted angerSad coordinates are consistently further from the center of the plot than the happySad coordinates (Figure 3).

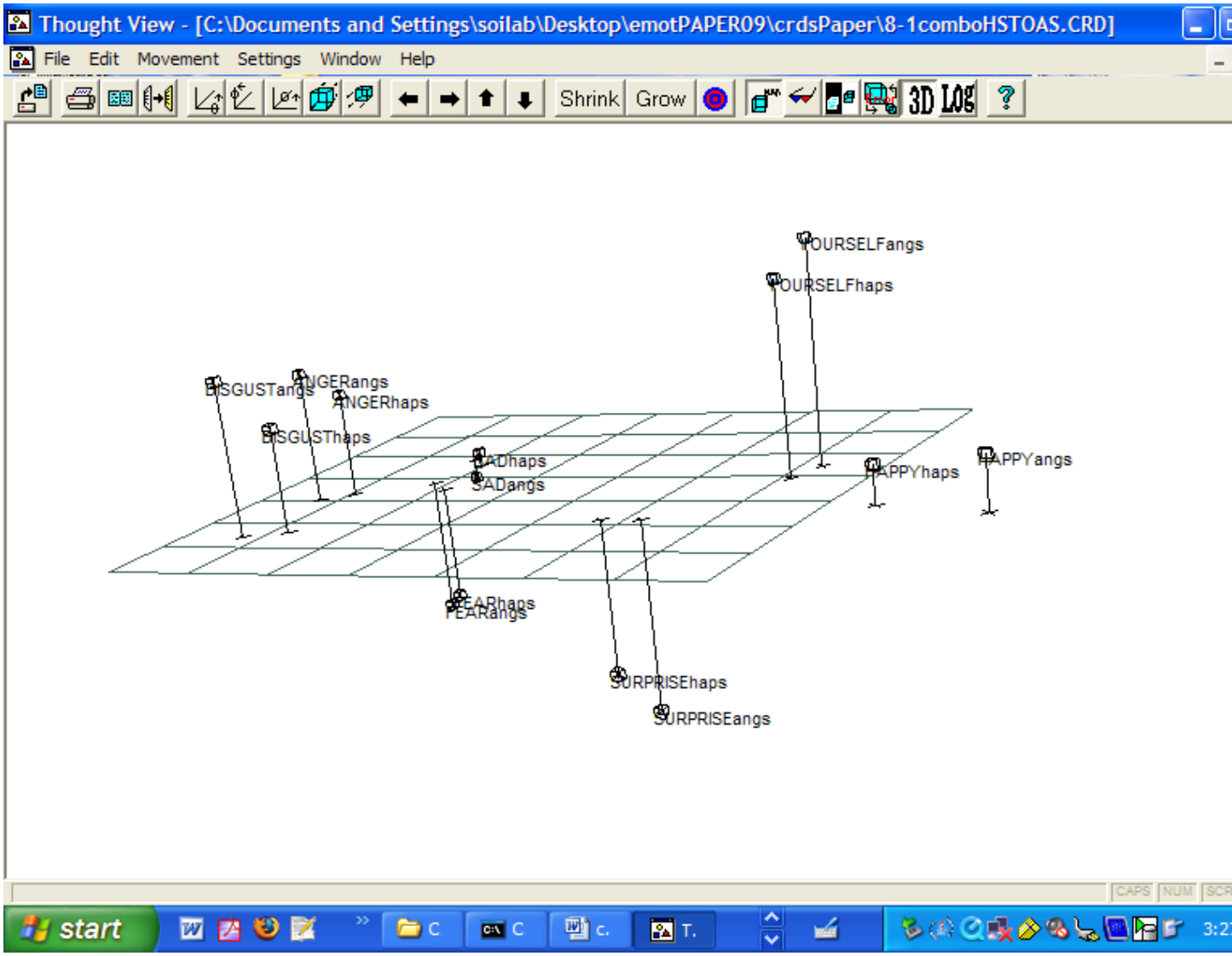

Figure 3: HappySad and angerSad pair responses, 3D combination plot

Also note that, as shown in Figure 4, it does not matter overall if the angerSad pair responses are rotated to the happySad pair responses or vice versa; the shape of the space and relation between the concepts one to another within a particular space is maintained regardless of which response set was used as the mainspace.[1]

[1] A mainspace is the set other sets are compared to in a particular rotation, thus serving as a reference frame; a reference frame may be considered "…any set of objects taken collectively which serves as a standard of reference" (Woelfel & Fink, 1980).

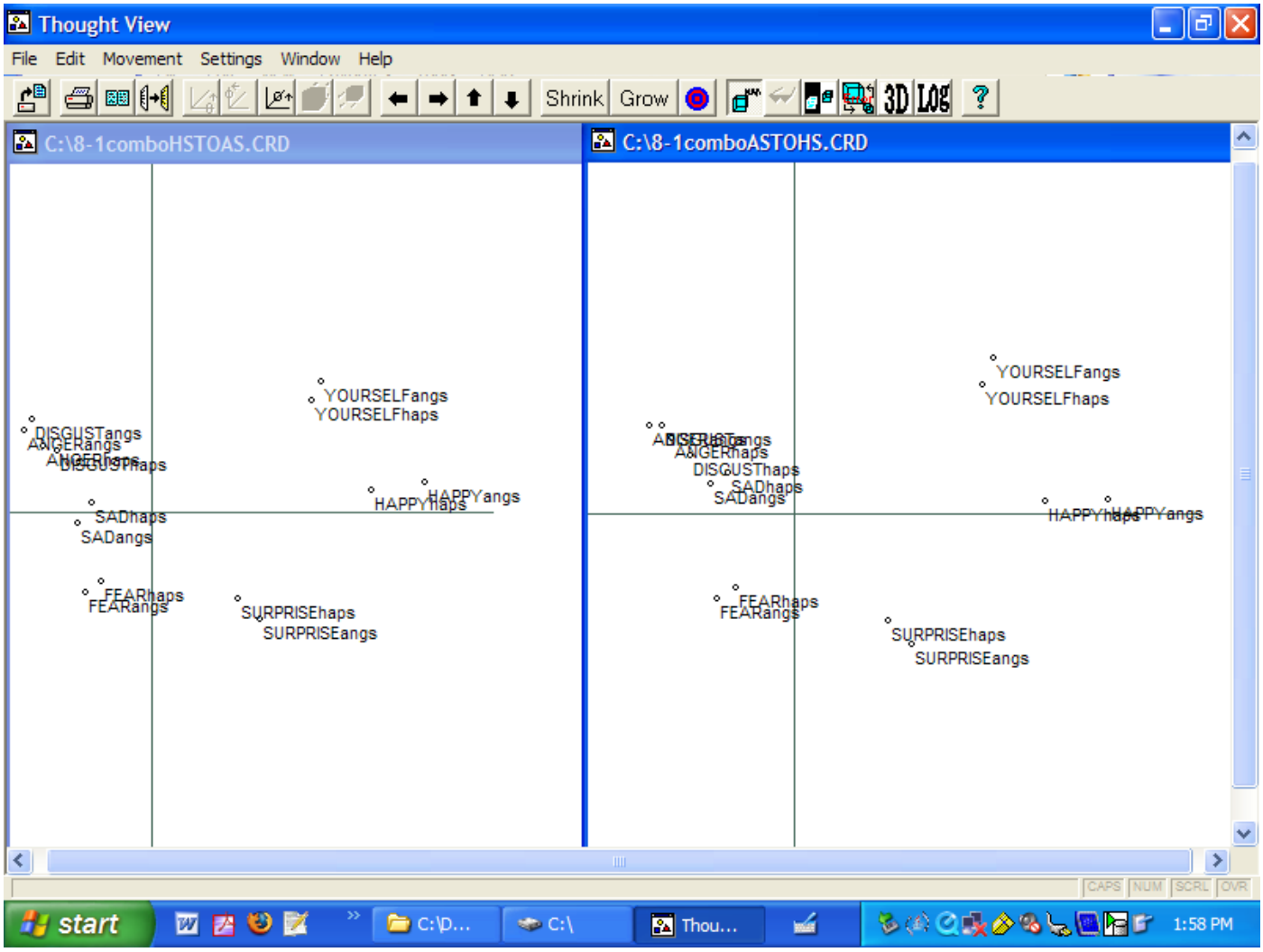

Figure 4: HappySad and angerSad pair responses, 2D combination plots (AngerSad as mainspace is on the left, HappySad as mainspace is on the right)

The placement of the concepts "anger" and "sad" did appear to shift somewhat when they were used in the criterion pair; when results were rotated using happySad as the mainspace, "anger" and "sad" were closer together than when angerSad was used as the mainspace. So, relatively speaking, which criterion pair was used made more of a difference than whether images or words were used--although the difference was small in both cases.

Indeed the average mean value for image responses versus word responses was close enough for each to potentially be (albeit just barely) within the margin of error of the other; the lowest potential mean standard error value (79.10538) for the criterion pair angerSad responses,

however, remained higher than the highest potential mean standard error value (72.73003) for the happySad criterion pair responses (Figures 5a, 5b, 5c, and Appendix G).

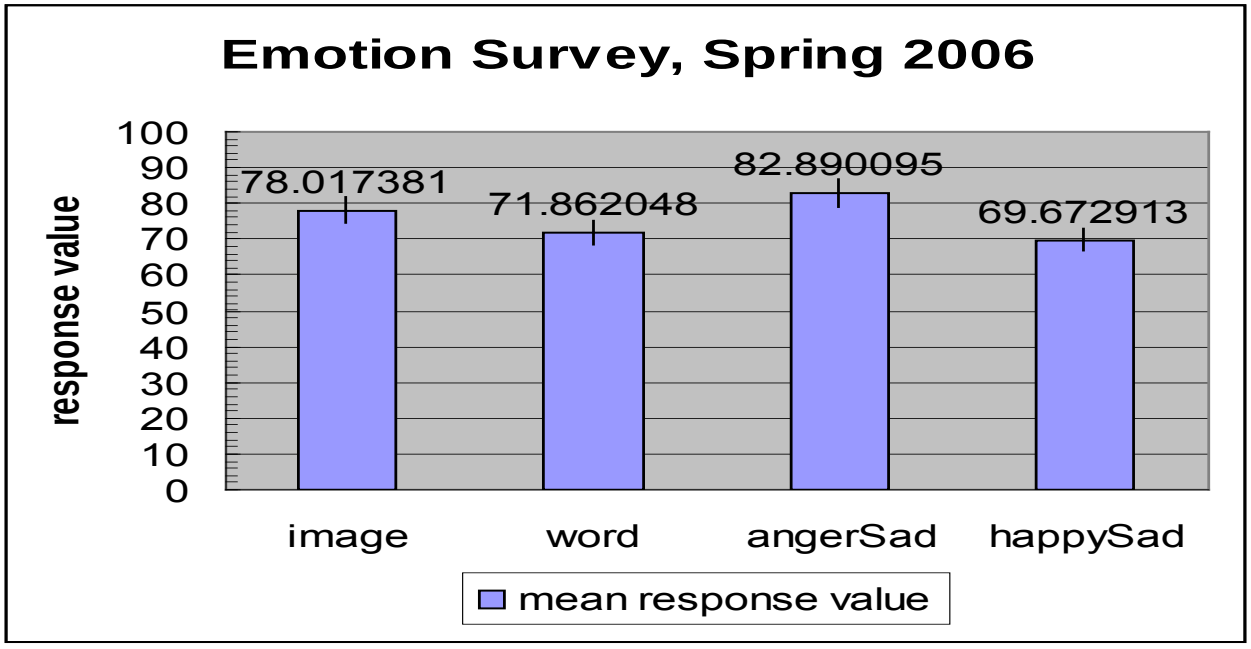

Figure 5a: Average mean response graph

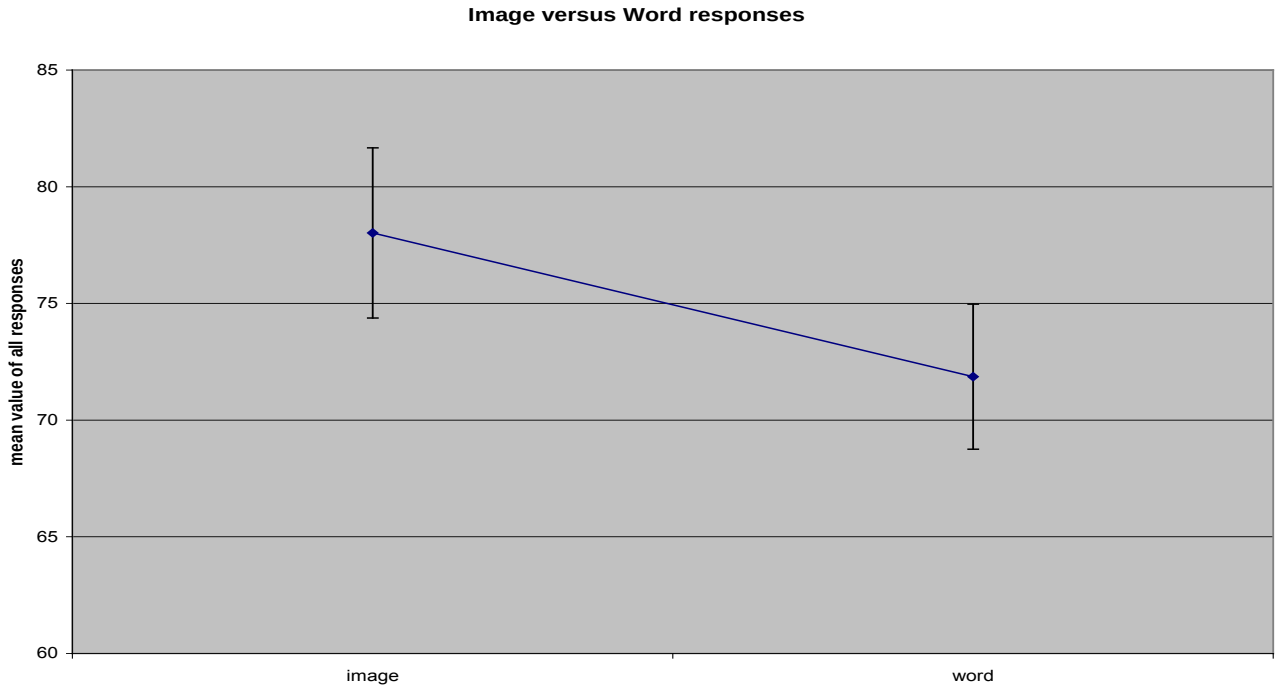

Figure 5b: Average mean response graph, image and word

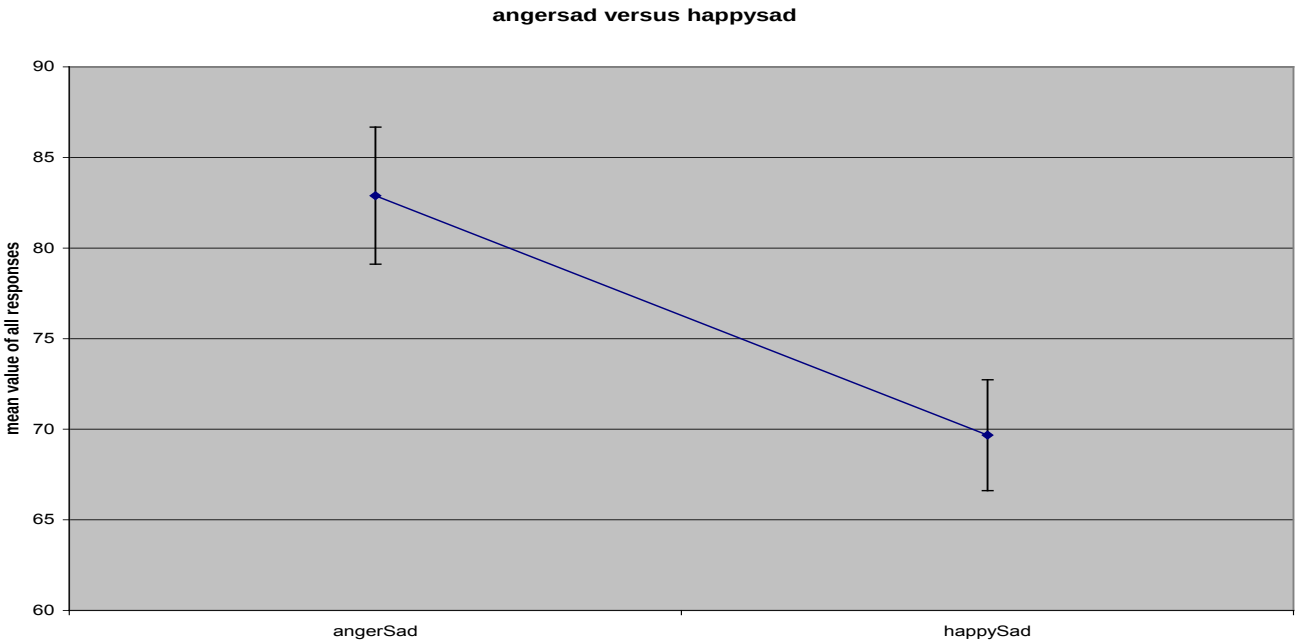

Figure 5c: Average mean response graph, angerSad pair and happySad pair

The small region of uncertainty (single-digit error values) around the mean response values seen in these survey results is notable; most surveys done by the author using this method have had double-digit standard error values[2]. The highest percent relative error[3] for any response pairs considered in this paper was the mean distance between anger and happy, 123.735, ± 4.017 (see Appendix H-4). As expected, the larger the sample size the lower the standard error values were (Reis & Judd, 2000); even when responses were further split by gender (thus reducing the number of responses per set) the mean standard error/set remained below ten. The smallest set, female angerSad image (Appendix F), had 33 total respondents and the highest mean standard error (9.647717); the highest standard error/concept pair in that dataset was 11.569 for "yourself"

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[2] "Standard error" is the same as "root mean square" (RMS). The formula is: $\sqrt{\frac{\sum_{i}^{n}(x_1 - \bar{x})}{N}}$

[3] "Percent relative error" is the standard (RMS) error expressed as a percentage of the mean. The formula is: $100(s/\bar{x})$

and “sad” and the highest relative error/concept pair in that dataset was 20.1 for “yourself” and “disgust”. There were 32 responses in this small subset for the pair “yourself” and “sad” and only 30 responses for the pair “yourself” and “disgust”; the mean response value for “disgust” and “yourself” was lower (40.875) than for “yourself” and “sad” (87.172). Appendix F lists complete standard error mean values for all datasets examined using no maximum value, a maximum value two standard deviations from the mean average value, and a maximum value three standard deviations from the mean average value.

Extreme Responses (Outlier Data)

Extreme response values were originally excluded from the dataset by using a maximum value of three average standard deviations added to the average response mean; for this particular dataset, however, utilizing values only two average standard deviations from the average response mean (as per Chauvenet’s criteria) did not exclude many additional values. It was also felt that since the initial response means included all outlier values no matter how extreme, those values had already contributed to the final results by influencing the initial average mean values. By then subsequently excluding these outliers, the remaining values allowed a better picture of the average data values for each set to emerge. So it was not so much a question of not taking the extreme values into account as taking all the other values into account.

Maximum values for each result subset for both two and three standard deviations were initially computed for each data subset; after examination, however, it was determined that an equally good way to compare all the result sets to each other was to use the same maximum value to exclude outliers in all response sets. Results considering all responses with no maximum value were therefore calculated and that average standard error value was then added twice to the

average mean response value to determine a single maximum value (290.22) that was then used in all subsequent analysis (Figure 6 and Appendix G).

image / word emotion

STANDARD ERROR: SD2 from mean particular to each set
(as shown in v56 on screen reports using variable maxVals)

	word	image	bothWrd&Img
bothAngHap&Sad	3.492049	3.623183	2.409041
happySad	3.864382	4.041087	2.805894
angerSad	5.378375	5.635665	4.287651

STANDARD ERROR: from print reports using maxVal 290.22 for all sets
(maxVal calculated using all response print report w/no maxVal & adding the average standard deviation twice to the response mean average)

	word	image	bothWrd&Img
bothAngHap&Sad	3.1092381	3.64614286	2.409095238
happySad	3.86438095	4.130333333	2.85414286
angerSad	4.86557143	5.66961905	3.784714286

Figure 6: Standard error information for nine subsets comparing use of a maximum value particular to each subset versus use of a single maximum value based on all responses.

When subset standard error was graphed, it was discovered that the responses for image, word, and both criterion pairs mirrored each other not only in the coordinate plots but also in relation to standard error.

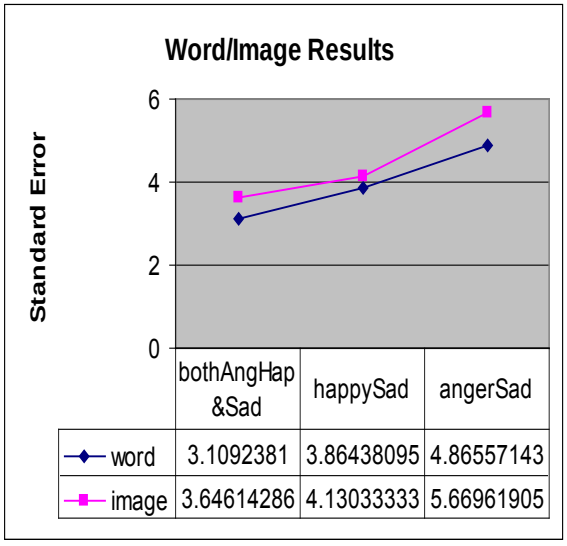

Figure 7: Standard error information for word and image responses inspected by criterion pair

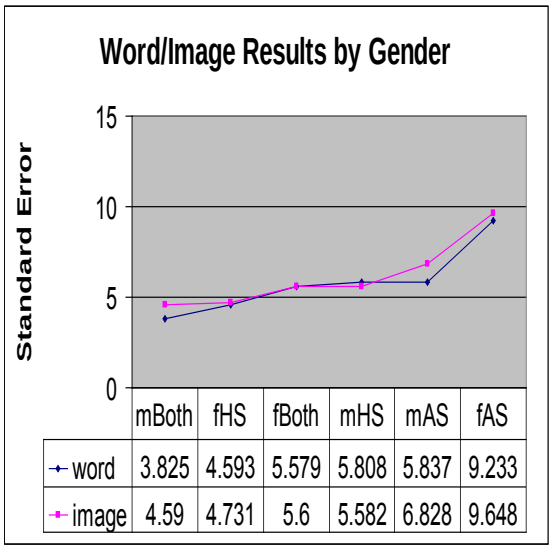

Figure 8: Standard error information for word and image responses inspected by criterion pair and split by gender

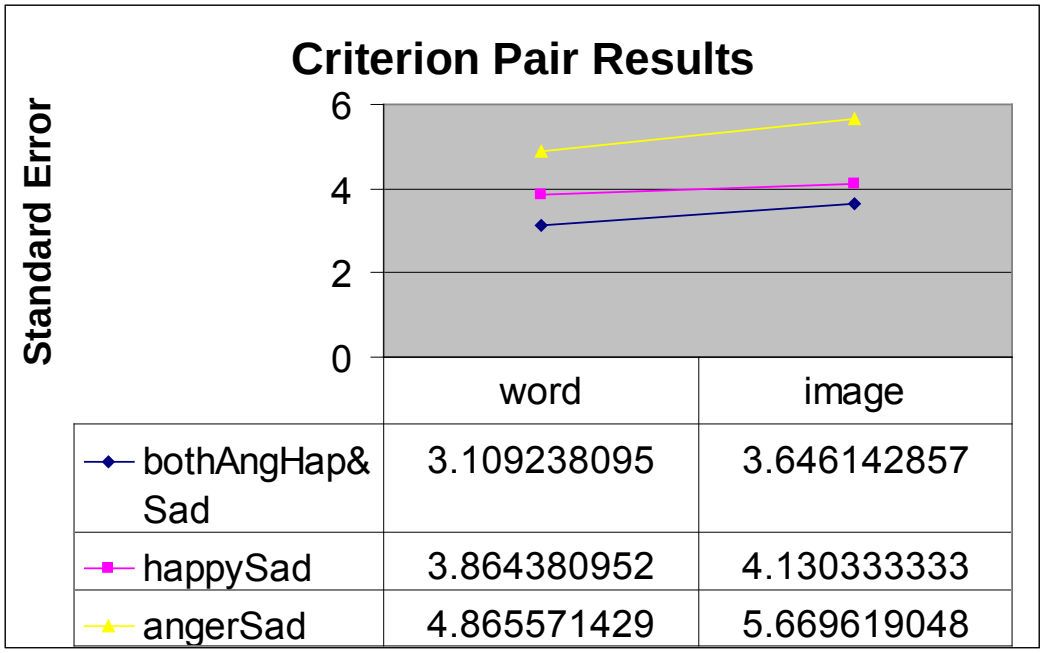

Figure 9: Standard error information for criterion pair responses inspected by word and image

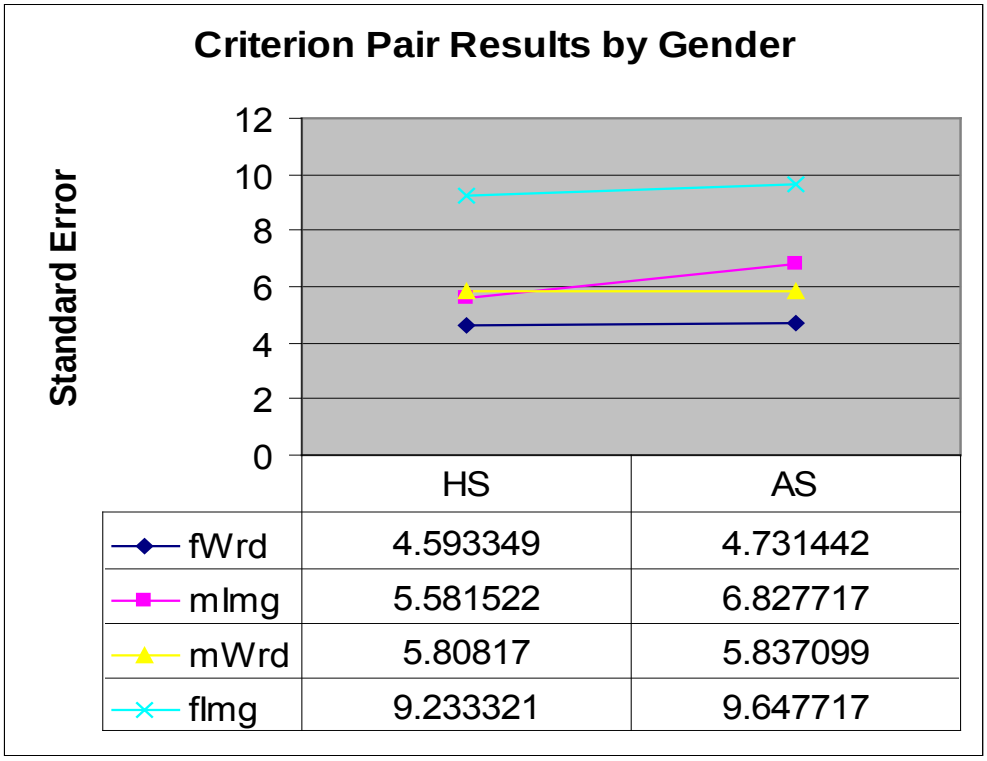

Figure 10: S tandard e rror i nformation f or c riterion pa ir r esponses i nspected b y w ord a nd image and split by gender

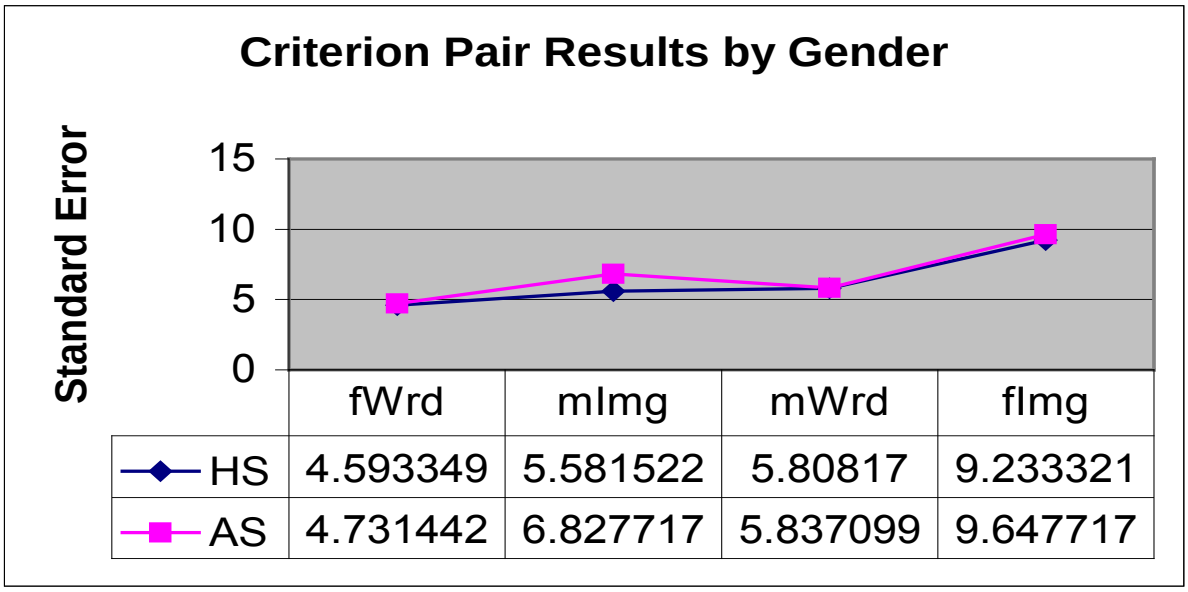

Figure 11: Standard error information for criterion pair responses inspected by word and image and split by gender

Standard error for each concept, rather than standard error for each concept pair, was also calculated (Appendix I). As noted earlier, minimal difference emerges when comparing image responses to word responses (1.817314 average standard error for all individual image concept responses and 1.7509 average standard error for all individual word concept responses; 3.646143 average standard error for all image pair responses and 3.109238 average standard error for all word pair responses). The largest difference seen, although still relatively small, was that standard error for all individual word concepts increased when the angerSad criterion pair was used. Standard error for "happy" was low when it was used as a concept in the criterion pair but higher when the criterion pair was angerSad. Since the standard error for "anger" and "sad" did not increase when the happySad criterion pair was used it is surmised that despite the criterion pair relationship indicated participants may nonetheless have wished to relate "happy" to "sad".

Response results were largely Euclidean (1.0 would represent a Euclidean space) with male angerSad word responses having the highest warp value (1.13). Warp values for other response sets are listed in Appendix F.

Discussion

The purpose of this study was primarily to examine the differences, if any, in the spatial representation of how people perceived emotion words and pictures of a person displaying those emotions. This was exploratory research so no specific hypotheses were being tested.

As suggested by Gordon & DeLeo's work (Gordon & DeLeo, 1976), the angerSad criterion pair did yield a larger numeric range in the responses. Also, few people using the happySad pair answered, for example, "19"; for the most part those responses were multiples of 5, 10, or 100. A noticeable number of angerSad pair respondents included such values, however, and all the decimal values entered but one were on angerSad surveys. It should perhaps also be noted that the angerSad surveys, especially the word surveys, exhibited more doodling and unusual responses in general than did the happySad surveys (the aforementioned values "pudding" and √25 were both on angerSad surveys).

Overall the word and image findings were similar, showing "happy" and "yourself" close to each other in the plots, "surprise" in the middle, and the negative emotions grouped together opposite "happy". Since most respondents indicated in the demographic question that they felt happy, the proximity of "yourself" to "happy" was not unexpected (Cheong, et al., 2010; Foldy & Woelfel, 1990). "Surprise" falling in the middle area between "happy" and the negative emotions was also not unexpected as there are many types of surprises, some pleasant and some not (Ekman, 2004, p. 150). Indeed Ekman and Friesen (2003, p. 35) note that nearly anything unexpected can be considered surprising. [4]

[4] It is striking that "surprise" never had the highest error and twice had the lowest error. It is possible that the idea of "surprise" may vary in meaning when additional information is considered (perhaps a situational concept, such as "cancer" might move "surprise" closer to "anger" or "sad" and away from "happy"); it is also possible, however, that its relation to other emotion concepts may not change.

The main difference observed in this study was in relation to the criterion pair results. As noted by Woelfel & Fink (1980, p. 68), "Different choices of standards will yield different realities" and Miller (1988) adds, "The stimuli are the pairs of concepts and the property being evaluated is the perceived differences among the pairs." Taken together these quotes paint a picture of "reality" as what it is perceived to be. Just as a person may come to believe car accidents happen mainly on highways, rather than local roads, if CNN is viewed exclusively, there is a sense in which a group as a whole can form and share ideas. In such a system the aggregate results (that individuals may neither be aware of nor intend) do not necessarily have any counterpart at the individual level (Schelling, 1978). In this study, the data suggest that one idea held by many students is that happy and sad are indeed 100 units apart but anger and sad are probably not. It also appears from the raw data responses that university level communication students are apparently loath to exceed a value of 100 on a survey. Nonetheless, the group as a whole did consistently evaluate the anger-happy pair and disgust-happy pair value as close to, or over, 100.

The expected spatial order of the negative emotions considered in this type of study usually seems to be "sad", "fear", and "anger" (Collier, 1996; Plutchik, 1962; Woelfel & Fink, 1980), howver, in one of Collier's four scaling solutions in experiment 2 (Collier, 1996) the order was "sad", "anger" ("angry"), and "fear" ("afraid"). Nancy Alvarado's results also displayed a variation in the spatial placement order of negative emotions. In her first experiment the order was "sad," "anger," "disgust," and "fear"; in her second experiment it was "sad", "fear", "disgust", and "anger"; and in her third experiment it was "fear", "anger", "disgust", and "sad" (Alvarado, 1996). Other research has ordered these emotions as "fear", "sad", "anger", and "disgust" (Dailey, Cottrell, Padgett, & Adolphs, 2002; Padgett, 1998).

In this study, it appears the spatial placement order of the negative emotions observed was most often “anger”, “disgust”, “sad”, and “fear” and occasionally ”disgust”, “anger”, “sad”, and “fear”. Nonetheless, caution needs to be used when interpreting plots; sometimes the concept order may appear to change when all that has really changed is their location in the concept space. The two plot rotations in Figure 12 were both created from the same data and the images in Figure 13a and 13b are merely 2d and 3d versions of the same datasets.

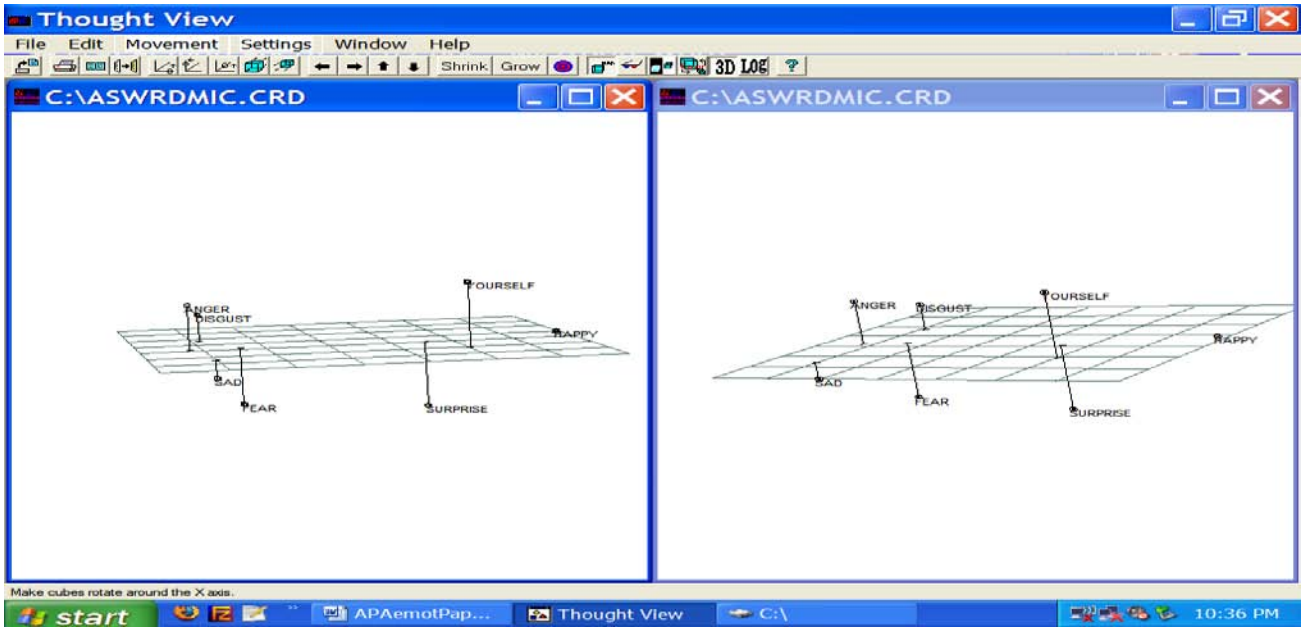

Figure 12: Two rotated views of the same angerSad word coordinates

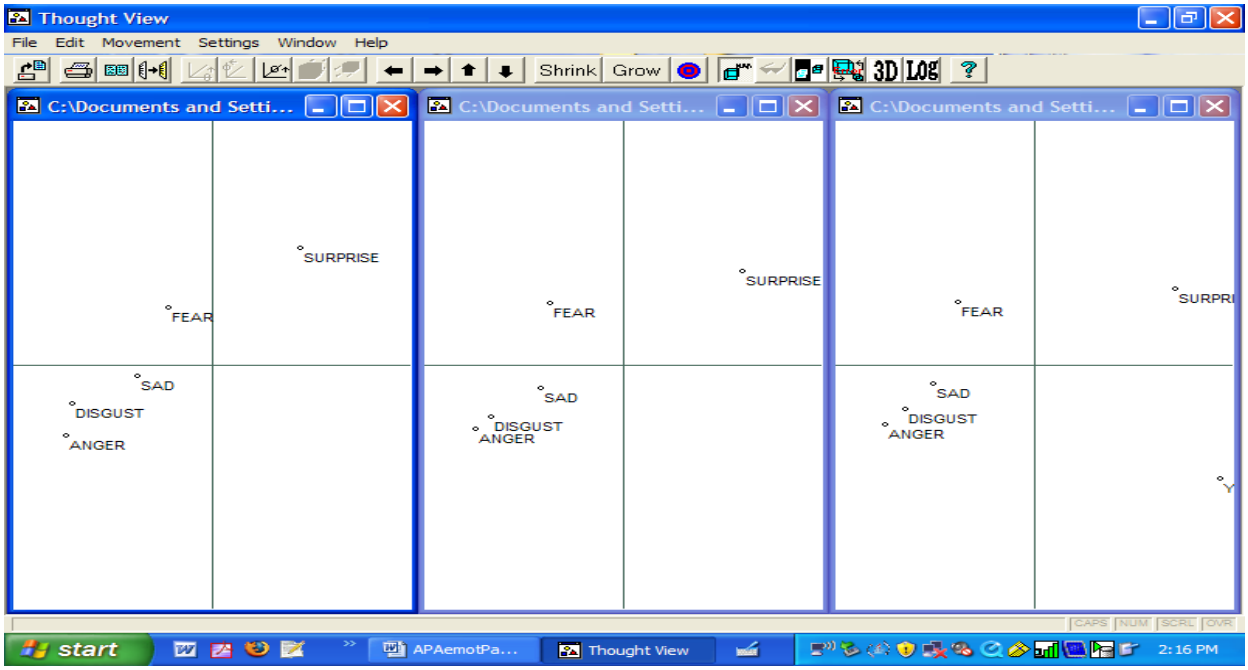

Figure 13a: 2D coordinate views

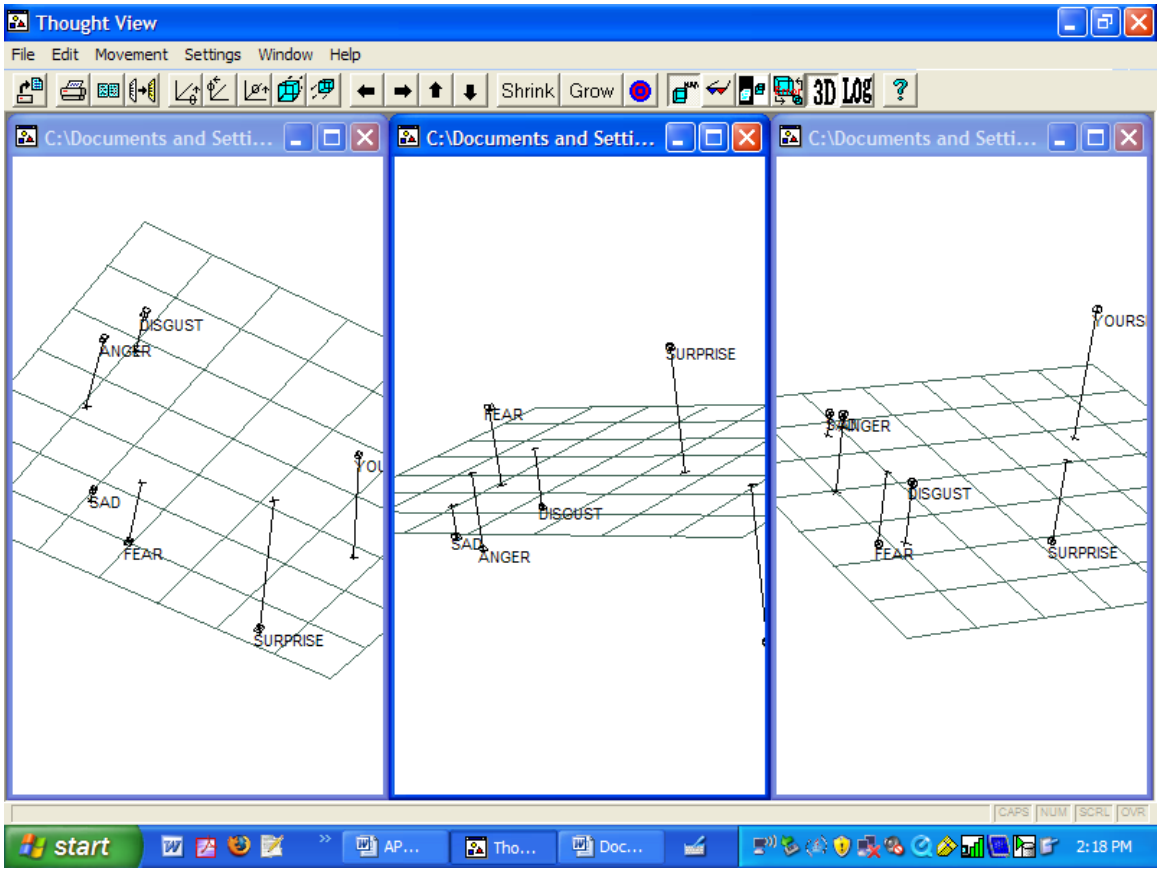

Figure 13b: minimally rotated (manual rotation) 3D plots of same datasets used in Figure 13a

Plots may therefore be instructive for quickly gleaning general trends, especially for concepts with large differences between them, but it is the print report numbers (statistics, scalars, and coordinates) that most accurately represent the data and allow sets to be compared. As illustrated by Figures 13a and 13b (above), that appears to be true for this present dataset even though the majority of variance is accounted for in the first three dimensions (Appendices J & K).

The results for "surprise" may warrant further investigation to confirm the lack of clear difference between the image and word spaces in relation to "fear" and "surprise". Since those concepts are often confused during facial recognition exercises, it seems incongruent that was not suggested in this research. Further, additional work using other images and words (such as logos and company names) to examine if they array in spatially similar ways is also desirable. Work comparing happySad, surpriseFear (the criterion pair used by Brandt and Barnett in 1976), and happySurprise as criterion pairs may further illuminate the criterion pair relationship to data responses.

It is proposed that in future research not considering the role of criterion pairs, the happySad concept pair be used rather than the angerSad pair. HappySad appears to be an unusually stable dichotomy, perhaps even useful as a standard measure. Toward that end, other datasets that have used these concepts should be reexamined, especially any that have contrasted a criterion pair using 100 with one using 1000. Although present respondents exceeded 100 in their responses often enough to show "anger" was perceived to be more different from "happy" than from "sad", overall respondents using the happySad pair appear to have wished to contain their responses within a range of 1-100. If use of a 1-100 scale is now a strongly held assumption, using 1-1000 may be confusing. If, on the other hand, that convention is merely

something respondents are used to from other surveys (or percentages), using a larger scale as the standard may be enough to allow additional variation among concepts as the concept set is increased. Preliminary tests also suggest it may be useful to rotate sets holding an emotion concept pair (or triad) stable while allowing other concepts to rotate freely.

In conclusion, the response difference between the image and word survey responses was negligible and a greater, although still small, response difference was seen between the surveys using different criterion pairs. Using the criterion pair with a smaller perceived distance between the concepts (angerSad) prompted a larger response scale and the criterion pair with a larger perceived distance between the concepts (happySad) prompted a smaller response scale—yet both generated largely equivalent spaces for the same seven concepts. Further work regarding criterion pairs and numeric scale values for such pairs is necessary.

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Appendix A

Word Survey

This survey asks you to consider how different or "far apart" different words are from one another. This difference can be measured in units, so the more different two words are, the more units apart they are.

Example: ANGER and SAD are [100] units apart.

Other words may be more, or less, than 100 units apart.

Please enter what you estimate the distance between words to be in the boxes below. You ("yourself") are a concept in this survey too. Judgements involving "yourself" should indicate how close you feel to a particular word.

Part 1 - Pair Comparisons

ANGER and DISGUST are	[ ] units apart	ANGER and FEAR	[ ] units apart
ANGER and HAPPY are	[ ] units apart	ANGER and SAD	[ ] units apart
ANGER and SURPRISE are	[ ] units apart	ANGER and YOURSELF	[ ] units apart
DISGUST and FEAR are	[ ] units apart	DISGUST and HAPPY	[ ] units apart
DISGUST and SAD are	[ ] units apart	DISGUST and SURPRISE	[ ] units apart
DISGUST and YOURSELF are	[ ] units apart	FEAR and HAPPY	[ ] units apart
FEAR and SAD are	[ ] units apart	FEAR and SURPRISE	[ ] units apart
FEAR and YOURSELF are	[ ] units apart	HAPPY and SAD	[ ] units apart
HAPPY and SURPRISE are	[ ] units apart	HAPPY and YOURSELF	[ ] units apart
SAD and SURPRISE are	[ ] units apart	SAD and YOURSELF	[ ] units apart
SURPRISE and YOURSELF are	[ ] units apart		

Part 2 - Demographic Questions (please write or circle answer)

Gender?	Female Male Would rather not say
What year were you born? (four digits: ex. 1989)	
How do you feel at this moment?	Happy Sad Something else

Thank you for your participation.

COM 101, 4/7/06

Appendix B

Word Survey

This survey asks you to consider how different or "far apart" different words are from one another. This difference can be measured in units, so the more different two words are, the more units apart they are.

Example: HAPPY and SAD are [100] units apart.

Other words may be more, or less, than 100 units apart.

Please enter what you estimate the distance between words to be in the boxes below. You ("yourself") are a concept in this survey too. Judgements involving "yourself" should indicate how close you feel to a particular word.

Part 1 - Pair Comparisons

ANGER and **DISGUST** are	____ units apart	**ANGER** and **FEAR**	____ units apart
ANGER and **HAPPY** are	____ units apart	**ANGER** and **SAD**	____ units apart
ANGER and **SURPRISE** are	____ units apart	**ANGER** and **YOURSELF**	____ units apart
DISGUST and **FEAR** are	____ units apart	**DISGUST** and **HAPPY**	____ units apart
DISGUST and **SAD** are	____ units apart	**DISGUST** and **SURPRISE**	____ units apart
DISGUST and **YOURSELF** are	____ units apart	**FEAR** and **HAPPY**	____ units apart
FEAR and **SAD** are	____ units apart	**FEAR** and **SURPRISE**	____ units apart
FEAR and **YOURSELF** are	____ units apart	**HAPPY** and **SAD**	____ units apart
HAPPY and **SURPRISE** are	____ units apart	**HAPPY** and **YOURSELF**	____ units apart
SAD and **SURPRISE** are	____ units apart	**SAD** and **YOURSELF**	____ units apart
SURPRISE and **YOURSELF** are	____ units apart		

Part 2 - Demographic Questions (please write or circle answer)

Gender?	Female Male Would rather not say
What year were you born? (four digits: ex. 1989)	
How do you feel at this moment?	Happy Sad Something else

Thank you for your participation.

COM 101, 4/7/06

Appendix C - 1

Image Survey

This survey asks you to consider how different or "far apart" different imagess are from one another. This difference can be measured in units, so the more different two images are, the more units apart they are.

Example:  and  are 100 units apart.

Other images may be more, or less, than 100 units apart.

Please enter what you estimate the distance between images to be in the boxes below. You ("yourself") are a concept in this survey too. Judgements involving "yourself" should indicate how close you feel to a particular image.

Part 1 - Pair Comparisons

 and  are	☐ units apart	 and  are	☐ units apart
 and  are	☐ units apart	 and  are	☐ units apart
 and  are	☐ units apart	 and **YOURSELF** are	☐ units apart
 and  are	☐ units apart	 and  are	☐ units apart
 and  are	☐ units apart	 and  are	☐ units apart

Appendix C - 2

 and **YOURSELF** are	units apart	 and  are	units apart
 and  are	units apart	 and  are	units apart
 and **YOURSELF** are	units apart	 and  are	units apart
 and  are	units apart	 and **YOURSELF** are	units apart
 and  are	units apart	 and **YOURSELF** are	units apart
 and **YOURSELF** are	units apart		units apart

Part 2 - Demographic Questions (please write or circle answer)

Gender?	Female Male Would rather not say
What year were you born? (four digits: ex. 1989)	
How do you feel at this moment?	Happy Sad Something else

Thank you for your participation.

COM 101, 4/7/06

Appendix D – 1

Image Survey

This survey asks you to consider how different or "far apart" different imagess are from one another. This difference can be measured in units, so the more different two images are, the more units apart they are.

Example:  and  are 100 units apart.

Other images may be more, or less, than 100 units apart.

Please enter what you estimate the distance between images to be in the boxes below. You ("yourself") are a concept in this survey too. Judgements involving "yourself" should indicate how close you feel to a particular image.

Part 1 - Pair Comparisons

 and  are	☐ units apart	 and  are	☐ units apart
 and  are	☐ units apart	 and  are	☐ units apart
 and  are	☐ units apart	 and YOURSELF are	☐ units apart
 and  are	☐ units apart	 and  are	☐ units apart
 and  are	☐ units apart	 and  are	☐ units apart

Appendix D – 2

 and **YOURSELF** are	units apart	 and  are	units apart
 and  are	units apart	 and  are	units apart
 and **YOURSELF** are	units apart	 and  are	units apart
 and  are	units apart	 and **YOURSELF** are	units apart
 and  are	units apart	 and **YOURSELF** are	units apart
 and **YOURSELF** are	units apart		units apart

Part 2 - Demographic Questions (please write or circle answer)

Gender?	Female Male Would rather not say
What year were you born? (four digits: ex. 1989)	
How do you feel at this moment?	Happy Sad Something else

Thank you for your participation.

COM 101, 4/7/06

Appendix E – 1

AS split by class:

56	101a
105	101b
17	101c
178	**total angerSad pair responses**

AS split by pair:

87	angerSadImage
91	angerSadWord
178	AS total

HS split by class:

56	101a
107	101b
10	101c
173	**total happySad pair responses**
351	total responses

HS split by pair:

79	hapSad Image
94	hapSad Word
173	HS total
351	All pair responses

Male/female all image/word both pairs:

68	femaleIMAGE
97	maleIMAGE
1	blankIMAGE
166	**total Image responses**
75	femaleWORD
110	maleWORD
0	blankWORD
185	**total Word responses**
351	all responses

Male Female totals by pair:

40	femASwrd
51	malASwrd
0	blank
91	total
33	femASimg
53	malASimg
1	blank
87	total
35	femHSwrd
59	malHSwrd
0	blank
94	total
35	femHSimg
44	malHSimg
0	
79	total
351	All mf responses

Male/female all AS/AS both image & word:

73	f Anger-sad pairs
104	m Anger-sad pairs
1	b Anger-sad pairs
178	AS total
70	f Happy-sad pairs
103	m Happy-sad pairs
0	b Happy-sad pairs
173	HS total
351	all responses

Appendix E - 2

Survey totals by course section:

com101a angerSad image=	30	(galileo.dat ID#133-157, 159-163)	*note 5
com101a angerSad word=	26	(galileo.dat ID#107-132)	
com101a happySad image=	30	(galileo.dat ID#136-164, 177)	*note 5
com101a happySad word=	26	(galileo.dat ID#110-135)	
	112	total COM101a	
com101b angerSad image=	47	(galileo.dat ID#59-85, 87-106)	*notes 2 & 3
com101b angerSad word=	58	(galileo.dat ID#1-58)	*note 4
com101b happySad image=	44	(galileo.dat ID#64-71, 73-109)	*note 1
com101b happySad word=	63	(galileo.dat ID#1-63)	
	212	total COM101b	
com101c angerSad image=	10	(galileo.dat ID#170-179)	
com101c angerSad word=	7	(galileo.dat ID#164-169, 181)	*note 6
com101c happySad image=	5	(galileo.dat ID#165-168, 170)	*note 7
com101c happySad word=	5	(galileo.dat ID#171-172, 174-176)	*note 6
	27	total COM101c	

total surveys= 351

note 1: ID#72 was skipped (not assigned) when numbering surveys.

note 2: ID#86 ASimage was originally assigned ID# & entered but then not counted (most pairs left blank)

note 3: survey 92 was not given ID# or entered; participant wrote words "less" & "more" instead of numeric values

note 4: ID #59 was assigned ID# but deleted as it contained multiple questionable responses such as "pudding" and √25

note 5: ID#177 HSimage was originally assigned ID #158 in ASimage.

note 6: ID#181 ASword was originally assigned ID #173 in HSword.

note 7: ID#169 Hsimage was originally assigned ID# & entered but then not counted (more pairs left blank than completed)

Appendix F

file(s)	what survey data it is...	#ofTotalResp	WARPsd2Max	maxVal3	maxVal2	maxVal1	ERRORnoMaxVal	ERRORmaxSD3	ERRORmaxSD2	ERRORmaxSD1
fallimg	IMAGE surveys; Both pairs, female resp	68	1.0292	304.8789	234.515		8.506866	6.989783	5.600246	
mallimg	IMAGE surveys; Both pairs, male respor	97	1.0039	355.6694	266.9664		9.007582	5.288491	4.589786	
allimg	IMAGE surveys; Both pairs, all response	166	1.0089	338.0875	255.8393		6.385064	4.221808	3.623183	
fallwrd	WORD surveys; Both pairs, female resp	75	1.072	451.3884	334.9604		13.4551	5.961337	5.578669	
mallwrd	WORD surveys; Both pairs, male respor	110	1.0918	390.3095	288.363		9.742586	4.460093	3.825378	
allwrd	WORD surveys; Both pairs, all response	185	1.0876	424.9027	313.8064		8.179821	3.614415	3.492049	
fhspair	IMAGE & WORD; HAPPYsad pair, female	70	1.0432	211.492	165.6114		5.486533	4.283245	3.515151	
mhspair	IMAGE & WORD; HAPPYsad pair; male r	103	1.0481	176.4535	138.9078		10.13101	3.053913	2.91331	
allhspair	IMAGE & WORD; HAPPYsad pair; all resp	173	1.0268	333.8756	248.4618		6.496309	3.280789	2.805894	
fhswrd	WORD surveys; HAPPYsad pair, female	35	1.0759	185.686	148.4016		6.306934	5.048864	4.593349	
mhswrd	WORD surveys; HAPPYsad pair, male re	59	1.0688	440.9744	322.0119		15.49415	6.064679	5.80817	
allhswrd	WORD surveys; HAPPYsad pair; all resp	94	1.0668	373.3626	275.6647		10.08161	4.390018	3.864382	
fhsimg	IMAGE surveys; HAPPYsad pair, female	35	1.0439	228.1737	176.7353		8.697658	5.676452	4.731442	
mhsimg	IMAGE surveys; HAPPYsad pair, male re	44	1.0183	293.2931	220.5324		10.96909	5.785448	5.581522	
hapsimg	IMAGE surveys; HAPPYsad pair, all resp	79	1.0273	270.8923	205.427	139.9618	7.366881	4.130315	4.041087	3.074982
fASpair	IMAGE & WORD: ANGERsad pair, female	73	1.0363	503.8782	376.6198		14.90177	10.53108	7.420451	
mASpair	IMAGE & WORD; ANGERsad pair, male	104	1.0626	350.6696	264.9357		8.423289	5.139724	4.515944	
Asall	IMAGE & WORD; ANGERsad pair, all res	178	1.0491	422.6008	316.7253		7.945617	4.69833	4.287651	
fasimg	IMAGE surveys; ANGERsad pair, female	33	1.0205	353.7525	274.6185		13.7745	11.52066	9.647717	
masimg	IMAGE surveys; ANGERsad pair, male re	53	1.0085	387.8712	292.4621		13.10879	7.644929	6.827717	
allASimg	IMAGE surveys; ANGERsad pair, all resp	87	1.0065	377.6458	287.3078		9.686829	6.550873	5.635665	
faswrd	WORD surveys; ANGERsad pair, female	40	1.0736	579.6081	428.697		23.88456	14.95327	9.233321	
maswrd	WORD surveys; ANGERsad pair, male re	51	1.1302	289.9718	221.5956		9.599965	5.874134	5.837099	
allaswrd	WORD surveys; ANGERsad pair, all resp	91	1.1143	449.2713	333.9612		12.11295	5.595199	5.378375	
note: WARP listed is from sets run alone, not rotated. When rotated slight differences, possibly due to error, were found in WARP amounts.										
for example: "male all images" warp was 1.0039 for set run alone but 1.0026 when rotated to male word responses.										
Warp was also slightly different depending on what maxVal was chosen. For example: "all words" with maxSD2 was 1.0876, maxSD3 was 1.0785, and no max was 1.0874										

Also, warps shown here are for maxVals 2sd for each individual set; warp for sets after all used the same maxVals (290.22) are slightly different (see Appendix J for angerSad & happySad and Appendix K for image & word as examples).

Appendix G

All Averages:

	N	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
image	166	78.01738095	45.985	3.646143	1.15642857	1.787619	159.381	3.952381	231.4286	4.990476
word	185	71.86204762	41.31585714	3.109238	1.00971429	1.5657619	177.1429	0.619048	209.0476	4.666667
angerSad	178	82.89009524	48.85952381	3.784714	0.891	0.9079524	167.4286	1.52381	229.0476	4.857143
happySad	173	69.67291342	43.1482381	3.057113	1.00324675	1.630342	176.3766	0.510823	211.7316	4.815152

value range w/error up & down from mean:

	high	low
image	81.66352	74.37124
word	74.97129	68.75281
angerSad	86.67481	79.10538
happySad	72.73003	66.6158

Appendix H - 1

image / word emotion data from print reports using 290.22 maximum value for all sets
(maxval was calculated by adding average 2sd to average response mean for all responses in prt report run with no maxVal)

ROW & COL numbers indicate concepts as follows:
1 ANGER
2 DISGUST
3 FEAR
4 HAPPY
5 SAD
6 SURPRISE
7 YOURSELF

Note that the Galileo model's comparative measurement technique generates a continuous, multidimensional Riemannian space to describe social objects, including self, utilizing equations used by physical scientists to model the motions of points in space. The magnitude estimations are generated by responses to paired comparison questions, often administered via surveys, which are then plotted as coordinates as per Young-Householder and Torgerson procedures for obtaining a double-centered scalar products matrix from a matrix of dissimilarities (Torgerson, 1952; Young & Householder, 1938). A method discovered by Karl Jacobi in 1849, implemented in a mathematical algoithm by Johannes Van de Geer (1971), and incorporated into the Galileo FORTRAN program by Kim Blaine Serota and Richard A. Holmes in 1975 (Serota, Fink, Noell, Woelfel, 1976) is then used to calculate the eigenvalues and eigenvectors for this coordinate space (Woelfel & Evans, 2009). It should also be noted that although particular points are plotted, the location of these objects (also sometimes referred to as concepts), is best thought of as a field, rather than a discrete point. Where a particular point measured is located within this field at any given time is dependent upon the degree of uncertainty as expressed by the measurement of standard error (Woelfel & Pruzek, 2010).

The relational pattern of all concepts observed shows how respondents, as a group, view them (Vishwanath & Chen, 2006); this allows central tendencies of cultural belief systems to be investigated (Woelfel & Barnett, 1982). Concepts that are similar to one another are close to each other in this space; concepts that are dissimilar are distant. These relations (distances) are what define the concepts (Woelfel & Fink, 1980). Accordingly the self concept is located close to, or distant from, other concepts considered. Therefore we can say behavioral concepts that are closest to the self concept are performed most frequently while those seldom or never performed are more distant from the self concept. Extending this idea, media close to the self concept have been found to be utilized more than media further from the self concept (Cheong, et al., 2009).

Appendix H – 2

IMAGE Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	45.795	34.945	2.712	1.96	5.611	166	0	200	5.9
1	3	63.689	43.143	3.369	1.131	1.381	164	0	200	5.3
1	4	110.466	47.888	3.774	0.68	-0.285	161	10	200	3.4
1	5	53.427	37.189	2.904	1.057	1.507	164	0	200	5.4
1	6	88.571	46.655	3.654	0.985	0.349	163	9	200	4.1
1	7	95.839	48.314	3.881	0.627	0.344	155	0	200	4
2	3	71.866	53.031	4.141	1.319	1.297	164	4	250	5.8
2	4	112.077	53.532	4.286	0.708	-0.077	156	4	250	3.8
2	5	61.27	38.596	3.023	1.314	2.343	163	5	200	4.9
2	6	84.057	48.8	3.87	0.95	0.647	159	5	250	4.6
2	7	94.31	47.634	3.826	0.637	1.031	155	0	250	4.1
3	4	96.461	47.287	3.811	1.026	0.907	154	16	250	4
3	5	48.739	42.286	3.292	1.987	6.593	165	0	290	6.8
3	6	68.131	45.753	3.617	1.505	2.615	160	0	250	5.3
3	7	96.788	44.924	3.656	0.829	1.13	151	0	250	3.8
4	5	97.325	51.208	4.087	0.883	0.511	157	10	250	4.2
4	6	80.969	51.084	4.026	1.463	2.44	161	10	270	5
4	7	34.018	42.974	3.366	1.848	3.767	163	0	200	9.9
5	6	69.75	44.689	3.533	1.702	3.603	160	10	250	5.1
5	7	79.608	48.472	3.919	0.845	1.307	153	0	250	4.9
6	7	85.209	47.281	3.822	0.829	0.519	153	0	200	4.5
averages:		78.01738095	45.985	3.646143	1.15642857	1.787619	159.381	3.952381	231.4286	4.990476

Average observations per cell 159.3810

Count of all non-zero cells 21

Mean of all non-zero cells 78.0173

Cell with maximum distance is 4 2 Distance is 112.0769

Cell with minimum distance is 7 4 Distance is 34.0184

Appendix H– 3

WORD Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	37.571	29.97	2.209	1.525	3.872	184	0	200	5.9
1	3	50.661	36.885	2.727	1.285	2.627	183	0	200	5.4
1	4	112.684	40.372	3.087	1.185	0.898	171	0	200	2.7
1	5	50.115	34.509	2.551	0.912	0.858	183	0	200	5.1
1	6	81.48	44.89	3.374	0.936	0.727	177	0	200	4.1
1	7	81.557	50.916	3.86	0.717	0.393	174	0	200	4.7
2	3	61.845	41.653	3.096	1.212	1.738	181	0	200	5
2	4	104.378	48.375	3.689	0.508	0.249	172	0	200	3.5
2	5	59.484	43.687	3.221	1.707	3.896	184	5	270	5.4
2	6	82.631	41.702	3.143	0.661	0.843	176	3	200	3.8
2	7	92.157	50.073	3.818	0.53	0.412	172	0	200	4.1
3	4	99.047	45.356	3.458	0.714	0.702	172	0	220	3.5
3	5	56.7	36.359	2.71	1.239	2.506	180	0	200	4.8
3	6	59.594	38.393	2.862	0.99	1.642	180	0	200	4.8
3	7	86.622	47.673	3.635	0.734	1.053	172	0	250	4.2
4	5	106.928	40.741	3.153	0.974	2.061	167	5	250	2.9
4	6	32.368	26.96	1.998	1.249	1.499	182	0	150	6.2
4	7	33.536	37.909	2.818	1.607	2.931	181	0	200	8.4
5	6	70.017	43.776	3.272	0.887	0.981	179	0	200	4.7
5	7	80.197	47.227	3.591	0.844	1.649	173	0	250	4.5
6	7	69.531	40.207	3.022	0.788	1.344	177	0	200	4.3
averages:		71.86204762	41.31585714	3.109238	1.00971429	1.5657619	177.1429	0.619048	209.0476	4.666667

Average observations per cell 177.1429
Count of all non-zero cells 21
Mean of all non-zero cells 71.862
Cell with maximum distance is 4 1 Distance is 112.6842
Cell with minimum distance is 6 4 Distance is 32.3681

Appendix H - 4

AngerSad Criterion Pair Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	45.219	35.66	2.673	1.451	3.025	178	0	200	5.9
1	3	64.126	44.927	3.396	0.934	0.91	175	0	200	5.3
1	4	123.735	51.134	4.017	0.365	-0.928	162	10	200	3.2
1	5	61.67	40.116	3.024	0.779	0.68	176	0	200	4.9
1	6	92.688	48.333	3.707	0.682	-0.079	170	0	200	4
1	7	92.451	54.873	4.311	0.513	-0.269	162	0	200	4.7
2	3	75.77	51.979	3.941	1.037	0.624	174	4	250	5.2
2	4	119.93	56.21	4.472	0.411	-0.522	158	0	250	3.7
2	5	67.429	43.014	3.252	1.043	1.206	175	5	200	4.8
2	6	94.976	48.402	3.734	0.529	-0.1	168	3	200	3.9
2	7	100.92	54.939	4.316	0.488	-0.119	162	0	250	4.3
3	4	109.671	51.087	4.064	0.555	-0.025	158	0	250	3.7
3	5	59.948	42.239	3.211	1.449	4.555	173	0	290	5.4
3	6	74.606	46.86	3.594	1.121	1.596	170	0	250	4.8
3	7	98.384	50.887	4.036	0.713	0.528	159	0	250	4.1
4	5	115.353	53.571	4.289	0.608	-0.311	156	10	250	3.7
4	6	61.046	54.243	4.124	1.613	3.014	173	0	270	6.8
4	7	38.391	46.183	3.501	1.745	3.067	174	0	200	9.1
5	6	74.917	48.048	3.696	1.096	1.35	169	0	250	4.9
5	7	85.72	53.391	4.208	0.857	0.677	161	0	250	4.9
6	7	83.742	49.954	3.913	0.722	0.188	163	0	200	4.7
averages:		82.89009524	48.85952381	3.784714	0.891	0.9079524	167.4286	1.52381	229.0476	4.857143

Average observations per cell 167.4286
Count of all non-zero cells 21
Mean of all non-zero cells 82.8901
Cell with maximum distance is 4 1 Distance is 123.7346
Cell with minimum distance is 7 4 Distance is 38.3908

Appendix H -5

HappySad Criterion Pair Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	37.593	28.776	2.194	2.327	9.871	172	0	200	5.8
1	3	49.384	33.824	2.579	1.538	3.939	172	0	200	5.2
1	4	100.053	32.357	2.482	1.37	3.678	170	0	200	2.5
1	5	41.398	27.208	2.081	0.735	-0.198	171	0	125	5
1	6	77.071	41.853	3.21	1.298	1.77	170	10	200	4.2
1	7	84.246	44.881	3.473	0.714	1.098	167	0	200	4.1
2	3	57.287	40.761	3.117	1.779	4.418	171	0	250	5.4
2	4	96.988	42.831	3.285	0.661	1.002	170	1	200	3.4
2	5	53.093	38.32	2.922	2.311	7.927	172	5	270	5.5
2	6	71.569	38.311	2.965	1.175	3.151	167	10	250	4.1
2	7	85.576	40.827	3.178	0.34	1.582	165	0	200	3.7
3	4	86.685	38.041	2.935	1.064	2.193	168	1	200	3.4
3	5	45.797	35.144	2.68	1.831	5.132	172	0	200	5.9
3	6	52.618	33.59	2.576	1.384	3.579	170	0	200	4.9
3	7	84.579	41.085	3.208	0.569	1.346	164	0	200	3.8
4	5	90.131	34.239	2.642	0.36	2.691	168	5	200	2.9
4	6	49.212	37.115	2.847	1.206	1.564	170	0	200	5.8
4	7	29.029	32.757	2.512	1.229	0.576	170	0	150	8.7
5	6	64.894	39.396	3.022	1.459	3.588	170	5	250	4.7
5	7	74.261	40.874	3.182	0.513	2.05	165	0	250	4.3
6	7	70.024	36.792	2.847	0.761	1.811	167	0	200	4.1
averages:		66.73752381	37.09438095	2.854143	1.17257143	2.9889524	169.0952	1.761905	206.9048	4.638095

Average observations per cell 169.0952
Count of all non-zero cells 21
Mean of all non-zero cells 66.7374
Cell with maximum distance is 4 1 Distance is 100.0529
Cell with minimum distance is 7 4 Distance is 29.0294

Appendix H – 6

HappySad Word Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	37.022	29.142	3.022	2.202	8.853	93	0	200	8.2
1	3	45.624	32.682	3.389	1.472	3.698	93	1	200	7.4
1	4	103.685	33.167	3.458	1.367	3.854	92	0	200	3.3
1	5	40.828	26.826	2.782	0.674	-0.382	93	0	110	6.8
1	6	75.554	40.892	4.263	1.182	1.764	92	10	200	5.6
1	7	79.231	48.05	5.037	0.735	0.784	91	0	200	6.4
2	3	56.065	38.906	4.034	1.323	2.299	93	0	200	7.2
2	4	98.407	43.457	4.556	0.469	1.084	91	1	200	4.6
2	5	54.5	41.656	4.297	2.45	8.401	94	5	270	7.9
2	6	72.956	37.42	3.944	0.589	0.888	90	10	200	5.4
2	7	85.371	42.037	4.456	0.358	1.597	89	0	200	5.2
3	4	93.209	41.501	4.35	0.815	1.448	91	1	200	4.7
3	5	54.011	36.486	3.783	1.682	4.146	93	0	200	7
3	6	52.912	36.1	3.784	1.269	2.615	91	0	200	7.2
3	7	80.573	42.338	4.488	0.472	1.049	89	0	200	5.6
4	5	97.934	31.638	3.317	0.42	4.578	91	5	200	3.4
4	6	32.304	26.881	2.803	1.528	2.989	92	0	150	8.7
4	7	30.174	32.209	3.358	1.116	-0.061	92	0	100	11.1
5	6	66.402	37.828	3.944	0.669	0.715	92	5	200	5.9
5	7	77.077	41.759	4.377	0.571	2.502	91	0	250	5.7
6	7	66.478	35.587	3.71	0.354	0.739	92	0	200	5.6
average=		66.6817619	36.9791429	3.86438095	1.03414286	2.55047619	91.67	1.80952	194.285714	6.32857143

Average observations per cell 91.6667
Count of all non-zero cells 21
Mean of all non-zero cells 66.6817
Cell with maximum distance is 4 1 Distance is 103.6848
Cell with minimum distance is 7 4 Distance is 30.1739

Appendix H – 7

AngerSad Word Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	38.132	30.945	3.244	0.916	-0.24	91	0	120	8.5
1	3	55.867	40.301	4.248	1.061	1.729	90	0	200	7.6
1	4	123.165	45.412	5.109	0.861	-0.768	79	40	200	4.1
1	5	59.711	38.834	4.093	0.687	0.279	90	0	200	6.9
1	6	87.894	48.276	5.236	0.678	-0.006	85	0	200	6
1	7	84.108	54.063	5.934	0.661	-0.042	83	0	200	7.1
2	3	67.955	43.766	4.665	1.08	1.211	88	10	200	6.9
2	4	111.086	52.832	5.87	0.413	-0.482	81	0	200	5.3
2	5	64.689	45.359	4.781	1.082	0.894	90	5	200	7.4
2	6	92.756	43.72	4.715	0.603	0.564	86	3	200	5.1
2	7	99.434	56.821	6.237	0.424	-0.503	83	0	200	6.3
3	4	105.605	48.757	5.417	0.545	0.064	81	0	220	5.1
3	5	59.575	36.212	3.882	0.759	0.937	87	5	200	6.5
3	6	66.427	39.649	4.203	0.751	1.129	89	0	200	6.3
3	7	93.108	52.282	5.739	0.757	0.54	83	0	250	6.2
4	5	117.697	47.507	5.449	0.825	0.174	76	20	250	4.6
4	6	32.433	27.19	2.866	0.952	-0.051	90	0	100	8.8
4	7	37.011	42.926	4.55	1.659	2.929	89	0	200	12.3
5	6	73.839	49.229	5.278	0.869	0.52	87	0	200	7.1
5	7	83.659	52.684	5.818	0.894	0.723	82	0	250	7
6	7	72.835	44.654	4.843	0.924	1.041	85	0	200	6.6
average=		77.4755238	44.8294762	4.86557143	0.82861905	0.5067619	85.48	3.95238	199.52381	6.74761905

Average observations per cell 85.4762
Count of all non-zero cells 21
Mean of all non-zero cells 77.4755
Cell with maximum distance is 4 1 Distance is 23.1646
Cell with minimum distance is 6 4 Distance is 32.4333

Appendix H – 8

HappySad Image Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR	SKEWNESS	KURTOSIS	COUNT	MIN. VAL	MAX. VAL	ERROR
1	2	38.266	28.51	3.208	2.443	10.836	79	7	200	8.4
1	3	53.81	34.809	3.916	1.595	3.983	79	0	200	7.3
1	4	95.769	31.04	3.515	1.357	3.255	78	22	200	3.7
1	5	42.077	27.815	3.149	0.783	-0.1	78	0	125	7.5
1	6	78.859	43.155	4.886	1.383	1.587	78	20	200	6.2
1	7	90.25	40.258	4.618	0.867	1.653	76	5	200	5.1
2	3	58.744	43.079	4.878	2.124	5.665	78	10	250	8.3
2	4	95.354	42.316	4.761	0.884	0.848	79	20	200	5
2	5	51.397	34.057	3.856	1.782	4.297	78	10	200	7.5
2	6	69.948	39.512	4.503	1.751	5.324	77	10	250	6.4
2	7	85.816	39.64	4.547	0.309	1.389	76	0	200	5.3
3	4	78.974	32.08	3.656	1.307	3.41	77	20	200	4.6
3	5	36.127	31.022	3.49	2.226	8.159	79	0	200	9.7
3	6	52.278	30.67	3.451	1.516	4.926	79	5	200	6.6
3	7	89.333	39.298	4.538	0.778	1.619	75	14	200	5.1
4	5	80.909	35.094	3.999	0.516	1.855	77	10	200	4.9
4	6	69.154	37.749	4.274	1.037	0.962	78	10	200	6.2
4	7	27.679	33.551	3.799	1.336	1.176	78	0	150	13.7
5	6	63.115	41.345	4.681	2.168	6.032	78	10	250	7.4
5	7	70.797	39.767	4.623	0.402	1.165	74	0	200	6.5
6	7	74.373	38.006	4.389	1.14	2.36	75	20	200	5.9
average=		66.8109048	36.3225238	4.13033333	1.3192381	3.35242857	77.43	9.19048	201.190476	6.72857143

Average observations per cell 77.4286
Count of all non-zero cells 21
Mean of all non-zero cells 66.8110
Cell with maximum distance is 4 1 Distance is 95.7692
Cell with minimum distance is 7 4 Distance is 27.6795

Appendix H – 9

AngerSad Image Responses

ROW	COL	MEAN	STAN. DEV.	STD ERR.	SKEWNESS	KURTOSIS	COUNT	MIN VAL	MAX VAL	ERROR
1	2	52.632	38.812	4.161	1.611	3.392	87	0	200	7.9
1	3	72.871	48.059	5.213	0.748	0.254	85	10	200	7.2
1	4	124.277	56.315	6.181	0.093	-1.136	83	10	200	5
1	5	63.721	41.543	4.48	0.83	0.849	86	2	200	7
1	6	97.482	48.196	5.228	0.695	-0.228	85	9	200	5.4
1	7	101.215	54.686	6.153	0.382	-0.421	79	0	200	6.1
2	3	83.767	58.4	6.297	0.837	-0.14	86	4	250	7.5
2	4	129.234	58.463	6.662	0.342	-0.713	77	4	250	5.2
2	5	70.329	40.449	4.387	1.022	1.633	85	5	200	6.2
2	6	97.305	53.043	5.858	0.428	-0.641	82	5	200	6
2	7	102.481	53.207	5.986	0.571	0.286	79	0	250	5.8
3	4	113.948	53.412	6.087	0.52	-0.231	77	16	250	5.3
3	5	60.326	47.783	5.153	1.669	4.923	86	0	290	8.5
3	6	83.593	52.471	5.83	1.102	0.857	81	0	250	7
3	7	104.145	49.012	5.622	0.714	0.499	76	0	250	5.4
4	5	113.125	58.973	6.593	0.518	-0.7	80	10	250	5.8
4	6	92.072	59.129	6.49	1.248	1.224	83	10	270	7
4	7	39.835	49.58	5.378	1.739	2.776	85	0	200	13.5
5	6	76.061	47.037	5.194	1.357	2.237	82	12	250	6.8
5	7	87.861	54.368	6.117	0.803	0.546	79	0	250	7
6	7	95.628	52.919	5.992	0.472	-0.368	78	0	200	6.3
average=		88.6622857	51.2312857	5.66961905	0.84290476	0.70942857	81.95	4.61905	229.047619	6.75714286

Average observations per cell 81.9524
Count of all non-zero cells 21
Mean of all non-zero cells 88.6623
Cell with maximum distance is 4 2 Distance is 129.2338
Cell with minimum distance is 7 4 Distance is 39.8353

Appendix I

Concept standard error (root mean squared error) from MICROGAL print reports/maxVal=sd2 out from mean

concept	HSword	HSimage	All HS (both wrd+img)	ASword	ASimage	All AS (both wrd+img)	All image (both pairs)	All word (both pairs)
anger	1.8392	1.9536	1.3388	2.5393	2.6337	1.9291	1.6964	1.6716
disgust	2.0369	2.0553	1.4213	2.59	2.7964	2.0502	1.8273	1.7481
fear	1.9967	1.9546	1.4124	2.6179	2.808	2.0668	1.802	1.7326
happy	1.8301	2.0133	1.396	2.8891	3.1355	2.3732	1.9392	1.8391
sad	1.8852	1.9438	1.3287	2.8498	2.6168	2.1563	1.7077	1.7657
surprise	1.881	2.0915	1.4286	2.3972	2.9005	2.1946	1.87	1.5844
yourself	2.1307	2.2242	1.5241	3.0511	2.956	2.2808	1.8786	1.915
total of column values	13.6	14.236	9.8499	18.934	19.8469	15.051	12.7212	12.257
average of column values	1.9428	2.0338	1.40713	2.7049	2.83527	2.1501	1.817314	1.7509
total responses	94	79	173	91	87	178	166	185

highest error

lowest error

Appendix J - 1

GALILEO Coordinates of 7 Variables in Riemann Space for Data Set 1 - AS

Normal Solution

0		1	2	3	4	5	6	7
1	ANGER	-45.186	-18.846	-3.145	8.336	21.583	-0.047	-7.743
2	DISGUST	-43.126	-21.875	-28.31	-7.518	-14.35	-0.054	4.277
3	FEAR	-26.877	30.009	8.778	29.6	-8.449	0.074	2.56
4	HAPPY	75.145	-2.967	-10.171	4.632	-3.833	-0.007	-19.164
5	SAD	-29.4	9.063	28.499	-24.18	-5.236	0.023	-9.395
6	SURPRISE	25.442	37.83	-15.286	-14.411	10.192	0.094	12.356
7	YOURSELF	44.002	-33.214	19.635	3.54	0.093	-0.082	17.11

Eigenvalues (roots) of eigenvector matrix--

13718.620 4359.409 2423.187 1828.517 889.123 .027 -985.773

Percentage of variance accounted for by individual factors-

61.704	19.608	10.899	8.224	3.999	0	4.434
Cumulative total:	81.312	92.211	100.435	104.434	104.434	108.868

Percentage of variance accounted for by individual factors in their own spaces-

59.084	18.775	10.436	7.875	3.829	0.003	100.003
Cumulative total:	77.859	88.295	96.17	99.999	100.002	200.005

Sum of Roots 22233.110 ********* WARP FACTOR = 1.0443 **********

Number of dimensions in real space 5

Number of dimensions in imaginary space 2

Appendix J - 2

GALILEO Coordinates of 7 Variables in Riemann Space for Data Set 2 - HS

Normal Solution

0		1	2	3	4	5	6	7
1	ANGER	-39.065	-14.89	0.273	-9.498	12.883	-0.029	-0.64
2	DISGUST	-34.099	-10.243	27.705	4.936	-7.277	-0.02	-1.203
3	FEAR	-22.284	24.491	-11.395	-15.264	-8.033	0.048	0.093
4	HAPPY	59.302	1.841	4.562	-2.53	1.435	0.003	-12.619
5	SAD	-24.454	-5.621	-22.654	16.876	-1.435	-0.011	-4.081
6	SURPRISE	18.009	33.363	7.621	8.684	5.996	0.065	8.188
7	YOURSELF	42.591	-28.942	-6.112	-3.205	-3.569	-0.056	10.263

Eigenvalues (roots) of eigenvector matrix--

9438.504 2912.140 1526.966 724.465 336.246 .011 -350.142

Percentage of variance accounted for by individual factors-

64.7	19.962	10.467	4.966	2.305	0	2.4
Cumulative total:	84.662	95.129	100.095	102.4	102.4	104.8

Percentage of variance accounted for by individual factors in their own spaces-

63.183	19.494	10.222	4.85	2.251	0.003	100.003
Cumulative total:	82.677	92.899	97.749	100	100.003	200.006

Sum of Roots 14588.190 ********* WARP FACTOR = 1.0240 **********

Number of dimensions in real space 5

Number of dimensions in imaginary space 2

Appendix J - 3

The Rotated Coordinates of Space Number 1 - AS

		1	2	3	4	5	6	7
1	ANGEANGE	-37.852	-24.381	0.128	8.926	21.599	-0.061	-4.891
2	DISGDISG	-35.793	-27.411	-25.037	-6.928	-14.334	-0.068	7.128
3	FEARFEAR	-19.543	24.473	12.05	30.19	-8.434	0.06	5.411
4	HAPPHAPP	82.478	-8.502	-6.898	5.222	-3.817	-0.021	-16.313
5	SAD SAD	-22.066	3.527	31.771	-23.59	-5.22	0.009	-6.544
6	SURPSURP	32.776	32.294	-12.013	-13.821	10.207	0.08	15.208
7	YOURYOUR	51.336	-38.75	22.907	4.13	0.108	-0.096	19.962

The Rotated Coordinates of Space Number 2 - HS

		1	2	3	4	5	6	7
1	ANGEANGE	-32.176	-19.61	3.726	6.279	13.765	-0.038	1.07
2	DISGDISG	-28.011	-18.329	-22.061	-6.181	-10.201	-0.03	0.508
3	FEARFEAR	-14.665	20.848	7.611	19.311	-3.865	0.039	1.803
4	HAPPHAPP	66.212	-6.233	-3.011	2.486	-1.565	-0.006	-10.909
5	SAD SAD	-17.535	-2.805	26.212	-15.308	-2.272	-0.02	-2.371
6	SURPSURP	26.175	26.129	-12.477	-6.587	4.137	0.056	9.899
7	YOURYOUR	48.398	-33.187	14.256	1.718	-6.433	-0.066	11.973

Appendix J - 4

Distances moved in the interval between time 1 and time 2

Concept	1 (ANGER)	moved	10.038 units.
Concept	2 (DISGUST)	moved	11.212 units.
Concept	3 (FEAR)	moved	13.522 units.
Concept	4 (HAPPY)	moved	16.377 units.
Concept	5 (SAD)	moved	12.305 units.
Concept	6 (SURPRISE)	moved	11.949 units.
Concept	7 (YOURSELF)	moved	9.960 units.

The Mean Distance Between All Points in Space 1-AS and their Counterparts in Space 2-HS is 12.195

Row Vector Correlations Between Time 1 and Time 2

Concept	T 1 Magnitude	T 2 Magnitude	Scalar Product	Correlation	Angle
1	50.49	40.76	2055.14	0.998525	3.1
2	53.5	41.82	2242.77	0.997639	3.9
3	45.6	33.05	1494.4	0.991598	7.4
4	81.84	65.74	5375.87	0.999177	2.3
5	45.27	35.16	1567.28	0.984565	10.1
6	48.22	38.55	1834.36	0.986763	9.3
7	65.42	59.56	3864.5	0.991677	7.4

Col Vector Correlations Between Time 1 and Time 2

Concept	T 1 Magnitude	T 2 Magnitude	Scalar Product	Correlation	Angle
1	118.72	98.76	11697.67	0.997635	3.9
2	67.63	54.64	3663.67	0.99135	7.5
3	49.98	40.17	1974.55	0.983488	10.4
4	42.79	27.16	1154.12	0.99324	6.7
5	29.82	19.35	535.48	0.927898	21.9
6	0.17	0.11	0.02	0.958674	16.5
7	32.29	19.25	591.16	0.950951	18

Appendix K - 1

GALILEO Coordinates of 7 Variables in Riemann Space for Data Set 1 - image

Normal Solution

0		1	2	3	4	5	6	7
1	ANGER	-40.946	-21.396	-3.385	-9.299	20.852	0.044	-0.674
2	DISGUST	-38.809	-22.273	23.995	-5.596	-15.685	0.045	1.88
3	FEAR	-23.514	26.741	-25.555	-13.736	-9.681	-0.054	-3.524
4	HAPPY	66.153	-2.001	-4.764	-12.974	0.927	0.005	6.812
5	SAD	-21.758	2.33	-15.717	27.11	-0.903	-0.005	4.58
6	SURPRISE	8.698	42.469	26.782	4.822	6.962	-0.087	-1.611
7	YOURSELF	50.175	-25.87	-1.356	9.672	-2.472	0.053	-7.463

Eigenvalues (roots) of eigenvector matrix--

11178.480 4151.254 2229.125 1326.533 830.799 -.017 -142.067

Percentage of variance accounted for by individual factors-

57.109 21.208 11.388 6.777 4.244 .000 .726

Percentage of variance accounted for by individual factors in their own spaces-

56.697 21.055 11.306 6.728 4.214 .012 99.987

Sum of Roots 19574.100 ********* WARP FACTOR = 1.0073 **********

Number of dimensions in real space 5

Number of dimensions in imaginary space 2

MAXITER REACHED ON ROOT 4 TOLERANCE REDUCED TO .001000000

Appendix K - 2

GALILEO Coordinates of 7 Variables in Riemann Space for Data Set 2 - word

Normal Solution

0		1	2	3	4	5	6	7
1	ANGER	-42.172	14.847	2.904	10.845	12.213	-0.047	-9.029
2	DISGUST	-37.17	9.737	30.837	-11.793	-5.725	0.051	6.911
3	FEAR	-24.751	-26.748	-4.423	22.514	-7.512	-0.098	-2.252
4	HAPPY	68.405	-0.999	10.326	-2.733	-0.973	0.012	-22.956
5	SAD	-30.722	0.968	-28.77	-20.203	-2.701	0.089	-7.686
6	SURPRISE	27.743	-31.042	0.965	-8.204	7.483	0.036	18.244
7	YOURSELF	38.667	33.239	-11.84	9.572	-2.785	-0.041	16.768

Eigenvalues (roots) of eigenvector matrix--

11660.620 3101.031 2054.392 1338.125 310.344 -.025 -1334.376

Percentage of variance accounted for by individual factors-

68.071 18.103 11.993 7.812 1.812 .000 7.790

Percentage of variance accounted for by individual factors in their own spaces-

63.152 16.795 11.126 7.247 1.681 .002 99.998

Sum of Roots 17130.110 ********* WARP FACTOR = 1.0779 **********

Number of dimensions in real space 5

Number of dimensions in imaginary space 2

Appendix K - 3

The Rotated Coordinates of Space Number 1 - image

		1	2	3	4	5	6	7
1	ANGEANGE	-32.583	-25.707	-3.611	-7.687	20.44	0.053	-1.918
2	DISGDISG	-30.447	-26.585	23.769	-3.984	-16.097	0.054	0.636
3	FEARFEAR	-15.151	22.429	-25.781	-12.124	-10.093	-0.046	-4.768
4	HAPPHAPP	74.516	-6.313	-4.99	-11.362	0.515	0.013	5.568
5	SAD SAD	-13.395	-1.981	-15.943	28.722	-1.315	0.004	3.336
6	SURPSURP	17.061	38.157	26.556	6.434	6.55	-0.079	-2.855
7	YOURYOUR	58.538	-30.182	-1.582	11.284	-2.884	0.062	-8.706

The Rotated Coordinates of Space Number 2 - word

		1	2	3	4	5	6	7
1	ANGEANGE	-33.957	-23.147	-7.791	-5.339	14.41	-0.054	6.235
2	DISGDISG	-26.606	-28.334	20.23	-6.421	-13.845	0.044	-9.705
3	FEARFEAR	-24.231	22.695	-13.693	-12.974	-3.572	-0.105	-0.543
4	HAPPHAPP	74.184	4.838	1.548	-12.761	-2.074	0.005	20.161
5	SAD SAD	-20.321	-4.32	-12.139	36.785	1.011	0.081	4.891
6	SURPSURP	30.93	28.268	11.844	0.71	4.071	0.028	-21.038
7	YOURYOUR	48.028	-23.862	-30.659	-3.295	6.166	-0.049	-19.563

Appendix K - 4

Distances moved in the interval between time 1 and time 2

Concept 1 (ANGER) moved 1.148 units.
Concept 2 (DISGUST) moved 8.099i units.
Concept 3 (FEAR) moved 15.938 units.
Concept 4 (HAPPY) moved 6.091i units.
Concept 5 (SAD) moved 11.658 units.
Concept 6 (SURPRISE) moved 14.658 units.
Concept 7 (YOURSELF) moved 34.241 units.

The Mean Distance Between All Points in Space 1 and their Counterparts in Space 2 is 13.119

Row Vector Correlations Between Time 1 and Time 2

Concept	T 1 Magnitude	T 2 Magnitude	Scalar Product	Correlation	Angle
1	47	44.12	2077.14	0.998325	3.3
2	49.73	45.37	2298.79	0.981252	11.1
3	40.29	38.35	1419.91	0.919019	23.2
4	75.6	72.73	5521.27	0.995877	5.2
5	35.4	43.69	1513.19	0.978312	12
6	50.28	38.35	1892.02	0.981228	11.1
7	66.33	59.01	3354.87	0.857085	31

Col Vector Correlations Between Time 1 and Time 2

Concept	T 1 Magnitude	T 2 Magnitude	Scalar Product	Correlation	Angle
1	108.02	107.83	11422.82	0.980685	11.3
2	65.43	57.13	3634.14	0.972132	13.6
3	47.22	43.44	1410.85	0.687771	46.5
4	36.67	42.02	1392.84	0.903985	25.3
5	28.84	21.73	559.93	0.893516	26.7
6	0.13	0.16	0	-0.024992	91.4
7	12.37	37.27	343.41	0.74516	41.8

End Program GALILEO

rotating word to image both pairs PAU