Mixed Emotions: Can People Feel Happy and Sad at the Same Time?

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Abstract

I studied whether or not people can feel happy and sad at the same moment in time. Participants used a computerized procedure to continuously rate their feelings as they viewed backwardly masked faces designed to elicit pleasant, unpleasant, or mixed feelings. The backward masking procedure and grid were poorly calibrated as participants found all conditions to be unpleasant. Evidence is presented that participants did not perceive the mask faces as neutral. Directions for future studies are discussed.

Mixed Emotions:
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Nearly everyone can point to a time in their lives when they remember feeling both happy and sad. When I first came to college, I was happy to finally have the freedom of living on my own, but I was also sad when my parents first left me. Most people believe that they can feel these seemingly opposite emotions concurrently. The English word for this sensation is *bittersweet*. Another word, *ambivalence*, seems to corroborate this belief with its definition as "the coexistence of opposite attitudes or feelings" (*The American Heritage College Dictionary*, 1997). It is clear from anecdotal evidence such as my own personal experience that there is some phenomenon occurring when people believe that they can feel happy and sad at the same time. It is not as clear exactly what that phenomenon is. The belief is consistent with some current theories of affect, but inconsistent with others. Anecdotal reports of mixed emotions are the impetus for a heated debate of whether or not people can truly feel happy and sad at the same instant in time. Different models of affect predict different explanations for this phenomenon.

Circumplex Model

The circumplex model of affect specifies that people cannot feel happy and sad at the same instant in time. According to the cicrumplex model, in my case, I would have been aggregating different emotions, but at no single time would I have felt both happy

and sad. The circumplex model of affect was first proposed in 1980 by James Russell and has been supported by multiple studies since (Feldman, 1995; Feldman Barrett & Russell, 1998; Remington, Fabrigar & Vissar, 2000; for a review, see Russell & Feldman Barrett, 1999). The circumplex model is a way of ordering affect stimuli, such as words (Figure 1). Each word is defined by two components, valence and arousal. Valence is the degree of pleasantness of the word while arousal is its amount of activation. Everything to the right of center has a pleasant valence, while everything to the left is unpleasant. Likewise, everything above the center is high in activation and everything below, low in activation. This creates a circular arrangement of words that describes the relation of emotion words to each other and demonstrates the likelihood of feelings described by those words occurring simultaneously.

The valence dimension of the circumplex is bipolar. Accordingly, happy and sad are semantic opposites which are 180 degrees apart on the circumplex, indicating a strong negative correlation between the two. When immediate experience is measured (as opposed to remembered experience), the emotions “happy” and “sad” show a strong negative correlation (especially when measurement error is corrected; Green, Goldman, & Salovey, 1993; Feldman Barrett & Russell, 1998). According to this model, if someone feels any degree of happiness, they cannot feel sad in the same instant, and vice versa.

The Importance of Intensity and Time

The bipolar modeling of affect used by the affect circumplex has met multiple challenges. Diener and Iran-Nejad (1986) showed that positive and negative feelings can

co-occur at moderate levels (at high levels they were mutually exclusive). The experiment by Diener and Iran-Nejad (1986) does not weaken the circumplex model for three reasons. First, several positive and negative emotions such as "joyful" and "depressed" were measured but explicitly opposite pairs, specifically "happy" and "sad," were not used. Second, the method of measurement was not precise enough to measure specific instances. Measurements were taken during emotional events in the participant's lives, but not necessarily at the same instant in time. In this way it is possible for a subject to feel happy and sad in close proximity to each other without feeling mixed emotions that would invalidate the bipolar view. The question being investigated is not whether people can alternate between feeling happy and sad during a single event, but rather if they can feel happy and sad together at the same instant in time. Third, Diener and Iran-Nejad (1986) used ambiguous unipolar scales which have been shown to be implicitly interpreted by participants as bipolar (Russell & Carroll, 1999). The scales are intended to measure one emotion, ranging in intensity from "not at all" to "very much." However, participants do not treat the "not at all" response option as neutral, but rather as the opposite of the emotion being asked. When this happens, the scale does not measure emotion as it intends causing inaccurate results.

Evaluative Space Model

Cacioppo and Bernston's (1994) evaluative space model (ESM) also presents a challenge to the circumplex view that a person cannot feel happy and sad in the same instant in time. The ESM contends that positive and negative affect are derived from two distinct biological systems that can be coactivated, allowing opposite emotions such as

happiness and sadness to be experienced at the same time. Like other theories, the ESM describes positive and negative affect as being largely opposite in nature with reverse consequences and effects. When negative and positive emotions are coactivated in the ESM, the experience is expected to be "unpleasant, unstable and often short-lived (Larsen, McGraw and Cacioppo, 2001, p. 687)." For this reason, the ESM stresses that the positive and negative systems of affect are activated reciprocally in most circumstances, but maintain that positive and negative affect can be positively correlated, negatively correlated, or uncorrelated.

Larsen, McGraw & Cacioppo (2001) were the first to approach the question of bipolarity versus bivariance by studying specific events that might give rise to mixed emotion. In a series of three studies, they investigated whether or not participants in emotionally complex situations were more likely to experience mixed emotions than participants on a typical day. In Study 1, participants were given the same questionnaire before and after watching the film *Life is Beautiful.* Studies 2 and 3 attempted to test the hypothesis in ecologically valid situations. These studies investigated college students on two atypical days, move-out day and graduation day versus students on regular days. Each study used a questionnaire with 10 different emotions. Subjects were asked if they felt each emotion "right now, at this very moment" on unambiguous unpiloar rating scales. The ten emotions could be broken down into five emotion-word pairs (happy/sad, calm/tense, relaxed/stressed, pleased/displeased and excited/depressed). The results for Study 1 showed that 10% of participants reported feeling both happy and sad before viewing the film while 44% reporting feeling both after viewing the film. No other emotion pair showed such an effect. Studies 2 and 3 showed that an increased number of

students felt both happy and sad at the same time on either their move-out day or graduation day as opposed to a "typical" day during the middle of the semester (54% versus 16% for move-out day, 50% versus 20% for graduation day).

Larsen et al. concluded that they demonstrated people's ability to experience mixed emotions in the special situations studied. Although Laresn et al.'s (2001) studies are important, they do suffer from procedural limitations. First, the experiments did not measure emotional experience at well defined instances in time. Without ensuring the precision of the measurement moment, mixed emotions cannot be measured properly. In Larsen et al. (2001) ratings were only taken at two points. Once while in a normal state, and once either during or after being presented with the test condition. Therefore, when participants rated their feelings for the critical, mixed emotions condition they could have been rating the entire collection of feelings they had experienced (that day in the move-out and graduation day studies or since their first rating during the *Life is Beautiful* study) rather than rating their emotions at the present instance. Also, participants rated 10 different emotion terms. Making these ratings could take up to a few minutes and therefore do not represent one instant in time. Since the entire crux of studying mixed emotions is to determine whether people feel them concurrently during a specific moment, it is crucial to have participants capture how they are feeling in one instant.

The second major flaw in Larsen et al. (2001) was the manner in which the stimuli were presented. In previous studies, it has been speculated that participants have rated the properties of stimuli rather than how the stimuli actually made them feel. For example, if a participant were to be presented with a happy face, they might report

feeling happy even if they experienced no change in affect at all. In the experiments by Larsen et al. (2001), it is possible that participants were doing this. For example, they could report feeling sad after watching the movie because they remembered that sad scenes had occurred in the movie even if they didn't feel sad themselves. The situations that the participants were exposed to intentionally contained multiple emotions. Therefore it is possible that when participants rated their emotions during the critical condition they were using their memory to think back to both happy and sad stimuli that they had encountered rather than rating their feelings at that moment despite the instructions they received.

The Present Study

The present study was designed to assess whether people can experience pleasant and unpleasant feelings at an exact instant in time. To avoid the problem of time encountered in Larsen et al. (2001), I concluded that the optimal instrument for participants to measure their emotions would be a grid which continuously measured whether participants were feeling neutral, pleasant, unpleasant or both pleasant and unpleasant. While developing this device, it was learned that Larsen had independently conceived of the same device and had already developed it. It was this device, with minor modifications, which was used to measure emotions in the study.

A rigorous training procedure was developed to teach participants to use the grid effectively. The main component of the training procedure was three scenarios that would be read to participants (Appendix A). The first two scenarios described graduation and move-out day, which have been described as emotionally complex situations (Larsen,

McGraw & Cacioppo, 2001). The third scenario was the description of a breakup with a significant other. This is another situation where a person could experience both positive and negative feelings. The scenarios were written so that they would contain a variety of emotions.

The present study was also designed to present the stimuli in a manner different from Larsen et al. (2001). Some of the possible problems experienced by Larsen et al. (2001) can be addressed by eliminating the conscious perception of the stimuli by participants. To do this, a backward masking paradigm was used. Using a procedure developed by Whalen et al. (1998) and pictures of facial affect (Ekman & Friesen, 1976), participants were primed to feel either slightly pleasant or unpleasant. Participants were only able to consciously perceive neutral mask faces and were unaware of happy or fearful target faces which were presented subconsciously. In this way, participants would only be able to rate their own feelings and would not have the opportunity to rate the properties of any stimuli.

The circumplex model of affect does not allow for a person to feel both happy and sad at the same time. However, it does not exclude them from feeling both in close proximity to each other. A person could conceivable feel happy one moment and sad the next and then happy again. In complex situations, many emotions may be close at hand, and attention to these emotions can switch back and forth rapidly. This has been proposed by Daniel Kahneman (1999) who uses a Neckar cube as an analogy to this phenomenon. The two-dimensional drawing of a Neckar cube can be viewed as two distinct three-dimensional cubes. While either three-dimensional cube can be viewed alternately and in quick succession, both cannot be viewed at the same time. Similarly, a

person can find reason to be both happy and sad, and may feel both alternately, but just not at the same time.

The experiment was designed to contain 8 blocks of backwardly masked faces to be presented to the participants: two happy blocks consisting of only happy faces, two fearful blocks consisting of only fearful faces, two neutral blocks consisting of only neutral faces, and two mixed blocks consisting of half happy and half fearful faces. One mixed block presents happy faces first and one presents fearful faces first. It is my hypothesis that participants will report feeling pleasant and unpleasant, respectively, while viewing the happy and fearful blocks and will alternate feeling pleasant and unpleasant while viewing the mixed blocks, but will at no time report feeling both happy and sad in the same instant. These results would be consistent with bipolar theories of affect and the affect circumplex.

Method

Participants

Participants were 40 undergraduate students (12 men) from Boston College who were given research credit in exchange for their participation in the experiment.

Procedure

The experiment consisted of two phases, a training phase and a testing phase.

Training Phase

Participants were shown a paper copy of the affect grid (Figure 2) and the experimenter defined the dimensions of the grid to them. The grid was 7 squares by 7 squares and consisted of two dimensions, pleasantness and unpleasantness. The dimensions were counterbalanced across participants. The grid used by odd numbered participants had “pleasantness” along the X-axis and “unpleasantness” along the Y-axis. The grid used by even numbered participants had “pleasantness” along the Y-axis and “unpleasantness” along the X-axis. The square in the lower left hand corner was “neutral” and served as the point of origin for both grids. Pleasantness or unpleasantness increased the further squares were from the origin. All the squares in the middle of the grid were classified as being a mixture of pleasantness and unpleasantness.

Participants were also shown a color-coded version of the grid (Appendix B) to help them conceptualize it further. White coloring represented neutral; yellow, pleasantness; blue, unpleasantness and a mixture of pleasantness and unpleasantness were shown in green. The hue of the colors varied along with the intensity of the emotions. For example, the pleasantness dimension began as white or neutral. As the grid indicated pleasantness, the color started to change to yellow. Where pleasantness was slight, the color was light yellow. As pleasantness increased, the intensity of the yellow coloring also increased until extreme pleasantness which was deep yellow.

Next the participants were shown where three words would be fall on the grid. ”Love,” was placed along the axis indicating a high degree of pleasantness, ”Murder” was placed along the axis indicating a high degree of unpleasantness and ”Chocolate” was placed in the middle proportion of the grid to show that it contained elements of both

pleasantness and unpleasantness. Participants were told that chocolate tastes good giving it elements of pleasantness, but is also considered to be unhealthy, which is unpleasant.

Participants then viewed the computerized version of the affect grid which was identical in nature to the paper grid except that it contained no labels (the paper grid was kept nearby as a reference). On the computer grid, the square currently "activated" or what the participant was reporting feeling changed color from gray to blue. To indicate a change in feeling, participants moved a pen along a special touchpad that corresponded with the computer grid and a different square would turn blue. Only one square could be activated at a time.

The experimenter read three scenarios to the participants. Starting with the pen at neutral, participants were instructed to listen to the scenario, imagine themselves in the situation described and indicate how they would feel on the grid. As their feelings either increased or decreased in intensity, participants moved the pen accordingly. If their feeling remained unchanged participants were able to hold the pen steady and if they were no longer feeling anything, participants were instructed to move the pen back to neutral.

As they read the scenario, the experimenter monitored the progress of the participant to make sure that they understood the grid and were using it as defined. The experimenter periodically stopped the reading of the scenario to give the participant feedback and correct any errors. As the participant became more proficient in using the grid the experimenter corrected the participants less often. The first scenario described "graduation day" from college, the second scenario described "move-out day" after junior year and the third scenario described "breaking up" with a significant other (Appendix

A). During the third scenario, participants closed their eyes in order to experience the scenario in greater detail and also as practice for the test phase when they would no longer be able to see the grid on the computer screen as they made their ratings.

Testing Phase

After finishing the training phase, participants moved on to the testing phase. In the testing phase, participants were shown 8 blocks of backwardly masked faces. Each block consisted of 8 different faces presented 8 times each for a total of 64 trials on a black background. Each trial consisted of the target face (happy, fearful or neutral) being presented for 16ms followed by a neutral mask of the same identity for 128ms; thus each trial was 144ms long. Between each trial a white cross served as a fixation point for 400ms.

There were five types of blocks: happy (H) blocks which contained happy target faces, fearful (F) blocks which contained fearful target faces, neutral (N) neutral faces which contained neutral target faces and mixed-happy (MH) and mixed-fearful (MF) blocks which contained half happy and half fearful target faces. The mixed-happy block presented happy target faces for the first half of the block and fearful target aces for the second half. The mixed-fearful block presented fearful target faces for the first half of the block and happy target aces for the second half. The happy, fearful and neutral blocks were given to measure the validity of the experiment. The critical blocks were the mixed blocks which presented mixed stimuli and the opportunity to see if participants reported feeling mixed emotions. The first and eighth blocks were neutral blocks which served as a baseline. Blocks 2 through 7 consisted of two happy blocks, two fearful

blocks and two mixed blocks. These blocks were randomly presented for each participant.

Participants were instructed to rate how they were feeling using the touchpad as they viewed the faces. They were also instructed to not rate the faces, but to pay special attention to their own internal feelings. The coordinates of the blue square were recorded every 100ms during the trials as a two digit coordinate. This produced 350 measurement points for each block. At the end of each block, participants marked an "X" in a square of the paper grid to represent their summary judgment of the entire block (Figure 2).

Results

To begin, I examined whether participants' grid responses were calibrated to the stimulus blocks they viewed. This was an important step in order to ensure the meaningfulness of subsequent analyses. Neutral, happy and fearful blocks were examined. I expected that the neutral block would show little affect at all, the happy block would be reported mostly as pleasant and the fearful block would be reported mostly as unpleasant if the grid were calibrated well. Both the affect circumplex and ESM would predict these results. The mixed blocks could then be looked at to conclude whether or not mixed emotions occurred in those situations.

To analyze the data, I divided the affect grid into sections. The grid contains 49 cells each represented by a distinct set of coordinates. Initially, I grouped these into four types, 0,0; X,0; 0,Y and all remaining cells (Figure 4). Coordinate 0,0 represents neutral affect. X,0 represented pleasant affect such that it accounts for all cells along the X axis (ranging in pleasantness) with a zero coordinate for unpleasantness. 0,Y represented

pleasant affect such that it accounts for all cells along the Y axis (ranging in unpleasantness) with a zero coordinate for pleasantness. The balance of the cells (M) show some combination of pleasantness and unpleasantness and would indicate bivariance.

Because the conditions for a cell to be considered pleasant or unpleasant are very strict in this grouping of cells, this is said to be the "low tolerance" analysis for pleasant and unpleasant affect. The cells were also grouped in a second way to allow for a "higher tolerance" of pleasant and unpleasant affect to be considered. The second grouping contains another cell type defined as X,1 represented pleasant affect along with slight (rating of 1) unpleasant affect and 1,Y represented unpleasant affect along with slight (rating of 1) pleasant affect (Figure 5).

Responses for the two neutral blocks (N) were grouped together into one block for purposes of analysis. This was also done with the two happy blocks (H) and two fearful blocks (F). I then computed the total percentage of responses for all participants to have fallen within each type of section (total number of responses / [350 measurements instances * 40 participants * 2 blocks for N/H/F or 1 block for MH/MF] * 100) for each block. These total percentages would be the main means of analysis. Individual differences between participants were not analyzed.

Nowhere between any of the blocks do the percentage of neutral, pos/neg (sum of pleasant and unpleasant) or mixed responses vary significantly (Table 1). There was a higher rate of neutral responses for neutral blocks, but using a T-test found that this amount was not significantly different from the other blocks. I expected that the amount of neutral responses for neutral blocks would be much higher than the percentage of

neutral responses for the other blocks. The neutral blocks also had a high number of responses that were either positive, negative or mixed. This was unexpected and did not bode well for the correct calibration of the grid.

If the grid were calibrated correctly, I expected to find a high percentage of pleasant (X,0) responses and low percentage of unpleasant (0,Y) responses for the happy blocks. Conversely, I expected to find a high percentage of unpleasant (0,Y) responses and low percentage of pleasant (X,0) responses for the fearful blocks. The percentage of positive and negative responses for happy and fearful did not meet expectations. Both happy and fearful blocks showed a high percentage of negative responses in both the low tolerance (23.6% versus 24.3%) and higher tolerance (34.3% versus 35.7%) conditions (Table 2). There was also approximately the same amount of positive responses in each block, which was much lower than the percentage of negative responses (7.5%, 5.9% for low tolerance and 15.8%, 14.6% for higher tolerance). These results show that participants rated both the happy and fearful blocks as being largely unpleasantness with no significant differences between the two.

These results bring the validity of the entire backward masking procedure into question. If there are no difference between the happy and fear blocks and high degree of negative responses for all blocks, then this suggests problems with either (1) the grid or (2) the ability of backward masking of faces to induce affect. One hypothesis for these results is that the backward masking procedure's neutral mask faces were actually negative.

To test this, 20 new participants were asked to rate the 24 faces used in the experiment for their affect on a bipolar rating scale ranging from "very unpleasant" (-6)

to “very pleasant” (+6) with “neutral” (0) in the middle. In addition, 8 new neutral faces from the Japanese and Caucasian Facial Expressions of Emotion (JACFEE, Matsumoto and Ekman, 1988) were rated as well.

The results of the rated faces lend support to the hypothesis that the neutral faces were perceived by participants as negative. The happy and fearful faces were shown to be valid with means of 2.67, or pleasant and -3.02 or unpleasant (Table 3). The neutral faces used in the experiment were rated -1.31 or slightly unpleasant. Using a two-tailed T-test, the neutral faces were not significantly different from the fear faces (Table 4). This could explain the reason why all blocks were rated as generally negative. The neutral faces used may have caused participants to feel unpleasantness, much in the way the fear faces were intended to do. The JACFEE neutral faces returned a mean of 0.59, slightly pleasant, but were much closer to being neutral than the faces used in the present study.

I still proceeded to analyze the results to see whether or not mixed emotions occurred, but any findings must be viewed cautiously because of the questions regarding the validity of the experiment. According to both the ESM and the affect circumplex I would expect to find bipolarity during the majority of measurement instances, while according to the ESM, I would expect to find bivariance in certain instances, most likely during the mixed blocks. The crucial evidence for this is the responses that fall into the mixed (M) section. The question becomes what to considered sufficient evidence to determine the predominance of either the bipolar or bivalient views. There are two approaches that can be used to analyze the data.

The first method is a strict bipolar method. Since the bipolar theory of affect precludes finding bivariance in any single measurement instance, any substantial amount of bivariance would invalidate the bipolar theory. Therefore, by using this methodology, bipolarity (neutral, pleasant and unpleasant responses) would need to be found in the vast majority of measurement instances in order to indicate that a bipolar mechanism is occurring. A rate of 95% of cells indicating bipolarity would provide strong evidence for the bipolar view. While anything less, or any rate of bivariance greater than 5% would support the bivalient view.

Using the low tolerance condition, the burden to show bipolarity was not met, as the percentage of bipolar responses ranged from 53.1% to 59.1% (Table 5). None approached the 95% threshold. In the high tolerance condition, the amount of bipolarity found was higher, 72.2% to 80.5% (Table 6), but still fell short of 95%. These results did not meet the strict criteria for bipolarity.

The second way to analyze the data is a strict bivalient method. When using the low tolerance method, 73% of the cells (36 out of 49) can show evidence for bivarianece while only 27% (13 out of 49) show evidence for bipolarity. Therefore, considering chance alone, 73% of all responses would indicate bivariance. To find strong evidence for bivariance, the percentage of measurements showing bivariance would need to exceed what would be expected by chance, or more than 73%. The ESM would expect to exceed this amount in the mixed (MH and MF) blocks.

Using the low tolerance condition, evidence for bivariance was not found. The percentage of bivalent responses ranged from 40.9% to 46.9% (Table 5). These are less than what would be expected by chance if mixed emotions were present. Using the higher

tolerance condition, 51% (25 out of 49) of cells are expected to show bivariance by chance. As expected, the amount of bivariance found in the high tolerance condition is even less, ranging from 19.5% to 27.8% (Table 6). These results did not meet the strict criteria for bivariance. Neither the bipolar or bivalient theory were able to meet their strict criteria for any block. The overall results were inconclusive.

Finally, we also analyzed the data by session to see if there were practice effects or whether or not the ratings given by participants changed over time without respect to the block they were viewing. Session 1 and 8 were always neutral, while sessions 2 through 7 could be any of the other blocks. There were no clear differences between any of the sessions (Table 7). The amount of neutral, positive, negative and mixed responses were roughly the same for each session, meaning that time was not a factor in the results.

Discussion

Can people feel happy and sad at the same time? This is an important question to understanding how people experience emotion, but not one that is easily answered. In this study, I attempted to unconsciously prime affective responses in participants and measure feelings on a moment to moment basis. The findings indicated problems with the backward masking procedure. In addition, potential problems arose with the use of the continuous affect matrix. Important lessons were still be learned from the results that will allow further modifications of the experimental design to more successfully test the hypothesis in future studies.

Problems with the backward masking procedure

A backward masking procedure was used for the study so that participants would not be able to rate a consciously perceived stimulus. With only neutral faces to view consciously, I hoped that participants would have no choice but to rate their own affective experience. One hypothesis is that participants ironically continued to rate the stimulus, in this case the mask faces. In previous experiments, the faces had been perceived as neutral (Ekman and Friesan, 1976), but that is clearly not the case here. Despite explicit instructions to not rate the faces, participants seemed to do so. This created overabundant ratings of unpleasantness for all blocks including neutral and happy and rendered the intended prime to be useless.

It seems that participants had a hard time paying sole attention to their internal feelings. When a stimulus was present there was a natural inclination to rate it. This occurred even when participants were instructed not to do so and when the conscious stimulus did not provide much information to rate.

It has already been suggested that consciously perceived stimuli, such as a movie or an event occurring over the course of a day, are not a valid way to study mixed emotions because participants are able to use their memory to recall events of varying affective experience. Backward masking was not as successful as I hoped it would be in providing a stimulus to measure mixed emotions. It is possible that enhancements could be made to the procedure to produce better results. These enhancements would need to ensure that participants would not rate the neutral mask faces. Two possible changes to the procedure are the use of a better cover story, or an adjustment to the faces used. It is possible that the neutral mask faces were rated because the target faces were not effective

in inducing affect. It is also possible that the neutral mask faces were rated because they actually were valanced themselves (as suggested by the ratings collected after the initial experiment). If it is the second case, more current neutral faces (such as the JACFEE neutral faces) might serve as better masks. If the problem is with the target faces, the solution is not as simple, but might include longer presentations (which is difficult to do while remaining subconscious) or the use of different target faces.

Problems with affect matrix

A critical component of the experimental design involved using an affect matrix to measure emotions. The ability of the affect matrix to measure emotion in a continuous manner could be an essential part of answering the question of whether you can feel happy at the same time. The question centers on whether these mixed emotions can occur in one momentary instance. The matrix measured affect at 100ms intervals seemed to be a superior way to measure affect but the matrix proved to be more complicated of a measurement device than originally hoped.

I realized from the beginning that training a participant to use the matrix would be very important to its later use. If participants did not understand the matrix or used it incorrectly, their measurements of affect would not be valid. The matrix was thoroughly explained to participants followed by their active rehearsal on three scenarios. One thing that immediately became evident was the individual differences in how participants used the matrix. Training reduced these problems but did not eliminate them entirely.

The scenarios were written to contain many emotional experiences and thus had rapid affective changes. Participants often had a difficult time remaining in the present

moment and would often rate their memory of previous sentences as well. This caused a combination of situations to be rated together and often found participants lagging in the middle (bivalient) portion of the matrix. They would remember the positive affect of one sentence and the negative affect of another and then rate them together and report mixed emotions. This was a problem and indicated that participants were not using the matrix correctly. If questioned, participants would point to why they felt both pleasant and unpleasant. But often, the latest experience in the scenario would not be mixed, but strongly valanced in one direction (e.g. "You feel pure joy as you receive your diploma and the dean firmly shakes your hand."). This presented a challenge to the experimenter who could tell participants that they were incorrect and should only be representing pleasant feelings or could allow them to continue reporting their feelings as they were doing. If the former occurred, participants received the impression that mixed feelings were not appropriate causing the experimenter to have biased their performance. If the later occurred, participants falsely received the impression that they could aggregate their emotions – even over time – and cause the over-reporting of mixed emotions.

There were other problems with the matrix as well. Participants were asked to put themselves in the situation described and report how they would feel. But some participants reported that the feelings presented in the scenario would not coincide with their own. For example, in one scenario, participants were instructed that they felt sad when their parents left them alone at college, but this was not really the case for some participants. So in the training procedure participants were directed towards rating the stimulus while somewhat ignoring their own feelings, while in the testing phase

participants were asked to ignore the stimulus and rate their own feelings and not doing so proved to cause problems.

Finally, as with many rating devices, response bias influenced how participants rated their feelings. Demand characteristics caused participants to interpret how they thought the grid should be used. Even if a participant felt no mixed emotions, they attempted to utilize more of the matrix and report some mixed emotions for balance. Also, participants had a natural inclination to return to the middle (mixed) of the matrix rather than the origin (neutral) as a feeling changed or subsided. For example, someone who was feeling very pleasant and started to feel less pleasant would be inclined to move more towards unpleasantness by going diagonally across the matrix instead of moving laterally towards neutral by way of less pleasantness. All of these were potential problems with the measurements collected. The matrix and its training procedure clearly need to be better refined for future studies. One way is to have a demonstration of the matrix being used correctly. In this study participants were asked to use the matrix, likely having little experience rating their emotions in that way. If they saw the experimenter use the matrix, they would be able to model their own response in that fashion.

Future directions

Several alternate tests of the mixed emotion hypothesis are possible. One possibility would be to fix the problems encountered with the affect matrix as suggested earlier and after ensuring that the backwardly masked primes will be more effect by using better faces, repeat the current study. Overall, the method appears to be a good way to

study mixed emotions, but it didn't work as intended in this study. A follow-up study would see whether this set-up is able to test mixed emotions effectively.

Another option is to break up the backward masking procedure and affect matrix as there is some evidence that they don't work optimally together. Using the backward masking procedure – once again with new faces – measurements could be taken less often, perhaps at the end of each block. In this way, participants would not be viewing faces as they made their ratings, leading to less likelihood that they would actually be rating the faces. When participants did rate how they were feeling, they would only have their internal emotions to rely on. Continuous measurements would not be gathered like they were in the current study, but the measurements that would be taken would each account for one instant. This would not be a problem as most priming takes some amount of time to become most affective. Therefore, measurements could be taken during the time period when the prime would be most strong. Once again, there would be different blocks, intended to induce pleasant, unpleasant and a mixture of feelings. If mixed emotions do occur, the participant would still be experiencing them at the time of their rating.

Another option is to explore an option other than backward masking for inducing mixed emotions. It seems like an ingenious way to elicit mixed emotions, but if feelings can not be induced unconsciously in a reliable manner it is better to turn elsewhere. The next step may be to use multiple conscious stimuli. As the bipolar view predicts that mixed emotions is likely a matter of switching attention between available stimuli, an experiment using multiple, conscious stimuli might also be also to study mixed emotions. If participants were presented with conflicting stimuli, the bivalient

view would predict the reporting of mixed emotions, while the bipolar view would predict that in any instance, one of the stimuli would be perceived while the other ignored but close at hand if attention should switch. Measurements could be taken with the affect matrix or in some other manner.

Conclusion

The present study advances the question of mixed emotions by exploring the validity of new procedures and measurement tools. I largely failed to study mixed emotions as intended, but the study can still be investigated to find further ways to help study the question as intended. For now, the question of whether or not people can feel happy and sad at the same time remains unanswered. Previous evidence has been presented for both the bipolar and bivalent views, but so far, nothing conclusive has emerged. This study shows how difficult it is to approach the question correctly. Future studies have been proposed that will likely come closer to identifying the phenomenon of mixed emotions by keeping the lessons learned from this study in mind.

References

American Heritage College Dictionary (3rd ed.) (1997). Boston, MA: Houghton Mifflin Company.

Bargh, John A & Chartrand, Tanya L. (2002). The mind in the middle: A practical guide to priming and automaticity research. In Reis, Harry T. (Ed); Judd, Charles M. (Ed). *Handbook of research methods in social and personality psychology*, 253-285. New York, NY, US: Cambridge University Press.

Cacioppo, J. T., & Bernstein, G. G. (1994). Relationship between attitudes and evaluative space. A critical review, with emphasis on the separability of positive and negative substrates. *Psychological Bulletin, 115,* 401-423.

Diener, E. & Emmons, R. A. (1984). The independence of positive and negative affect. *Journal of Personality and Social Psychology, 47*, 1105-1117.

Diener, E., & Iran-Nejad, A. (1986). The relationship in experience between different types of affect. *Journal of Personality and Social Psychology, 50,* 1031-1038.

Diener, E., Smith, H. & Fujita, F. (1995). The personality structure of affect. *Journal of Personality and Social Psychology, 69,* 130-141.

Ekman, P., & Friesen, W.V. (1975). *Unmasking the face: A guide to recognizing emotions from facial clues.* New York, NY: Prentice-Hall.

Ekman, P. & Friesen. W. V. (1976). *Pictures of Facial Affect.* Palo Alto. CA: Consulting Psychologists Press.

Feldman, L. A. (1995). Variations in the circumplex structure of emotion. *Personality and Social Psychology Bulletin, 21,* 806-817.

Feldman Barrett, L. & Russell, J. A., (1998). Independence and bipolarity in the structure of affect. *Journal of Personality and Social Psychology, 74*, 967-984.

Green, D. P., Goldman, S. L., & Salovey, P. (1993). Measurement error masks bipolarity in affect ratings. *Journal of Personality and Social Psychology, 64*, 1029-1041.

Kahneman, Daniel (1999). Objective Happiness. In Kahneman, Daniel (Ed), Diener, Ed (Ed), Schwarz, Norbert (Ed). *Ill-being: The foundations of hedonic Psychology, 3-25.* New York, NY, US: Russell Sage Foundation.

Larsen, J. T., McGraw, A. P., & J. T. Cacioppo. (2001). Can people feel happy and sad at the same time? *Journal of Social and Personality Psychology, 81*, 684-696.

Laresn, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In Clark, M. S. (Ed), *Review of Personality and social psychology: Emotion, 13*, 25-29. Newbury Park, CA: Sage.

Matsumoto, D., & Ekman, P. (1988). Japanese and Caucasian Facial Expressions of Emotion (JACFEE) and Neutral Faces (JACNeuF). Human Interaction Laboratory, University of California, San Francisco, 401 Parnassus Avenue, San Francisco, CA, 94143.

Remington, N. A., Fabrigar, L. R. & Visser, P. S. (2000). Reexamining the circumplex model of affect. *Journal of Personality and Social Psychology, 79,* 286-300.

Russell, J. A. (1979). Affective space is bipolar. *Journal of Personality and Social Psychology, 37*, 345-356.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*, 1161-1178.

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

Russell, J. A., & Feldman Barrett, L. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology*, Special Section on the Structure of Emotion, *76,* 805-819.

Whalen, P. J., Rauch, S. L., Etcoff, N. L., McInerney, S. C., Lee, M. B., & Jenike, M. A. (1998). Masked presentations of emotional facial expressions modulate amygdala activity without explicit knowledge. *Journal of Neuroscience, 18,* 411-418.

Figure 1: Affect Circumplex

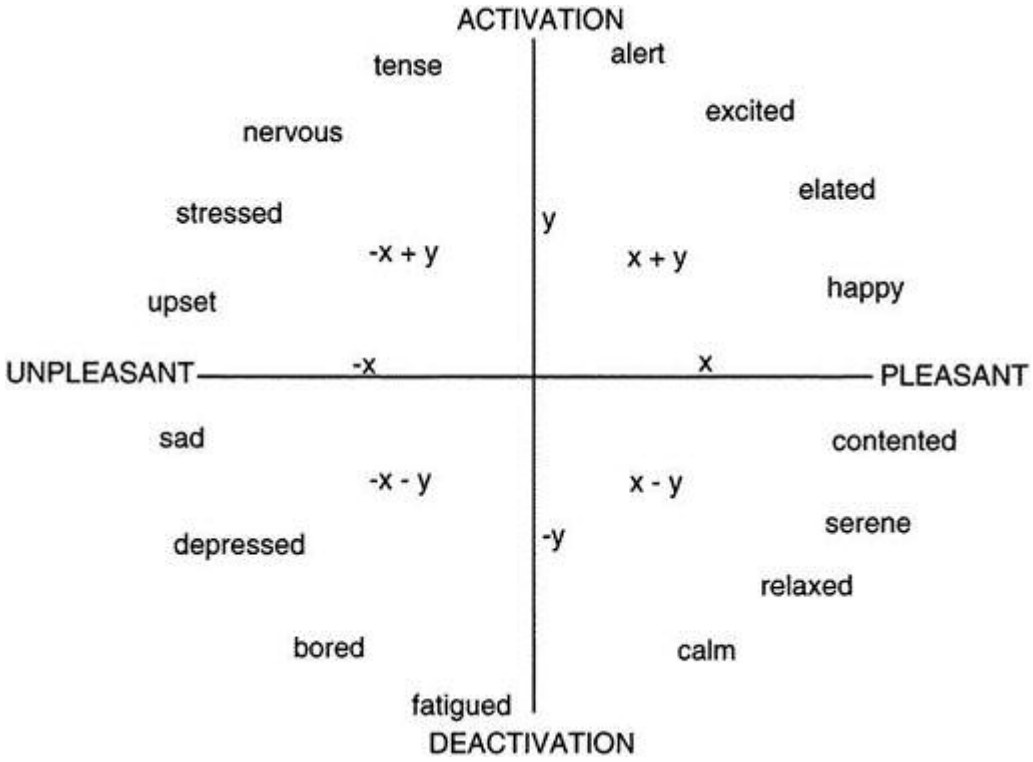

Figure 2: Affect Grid

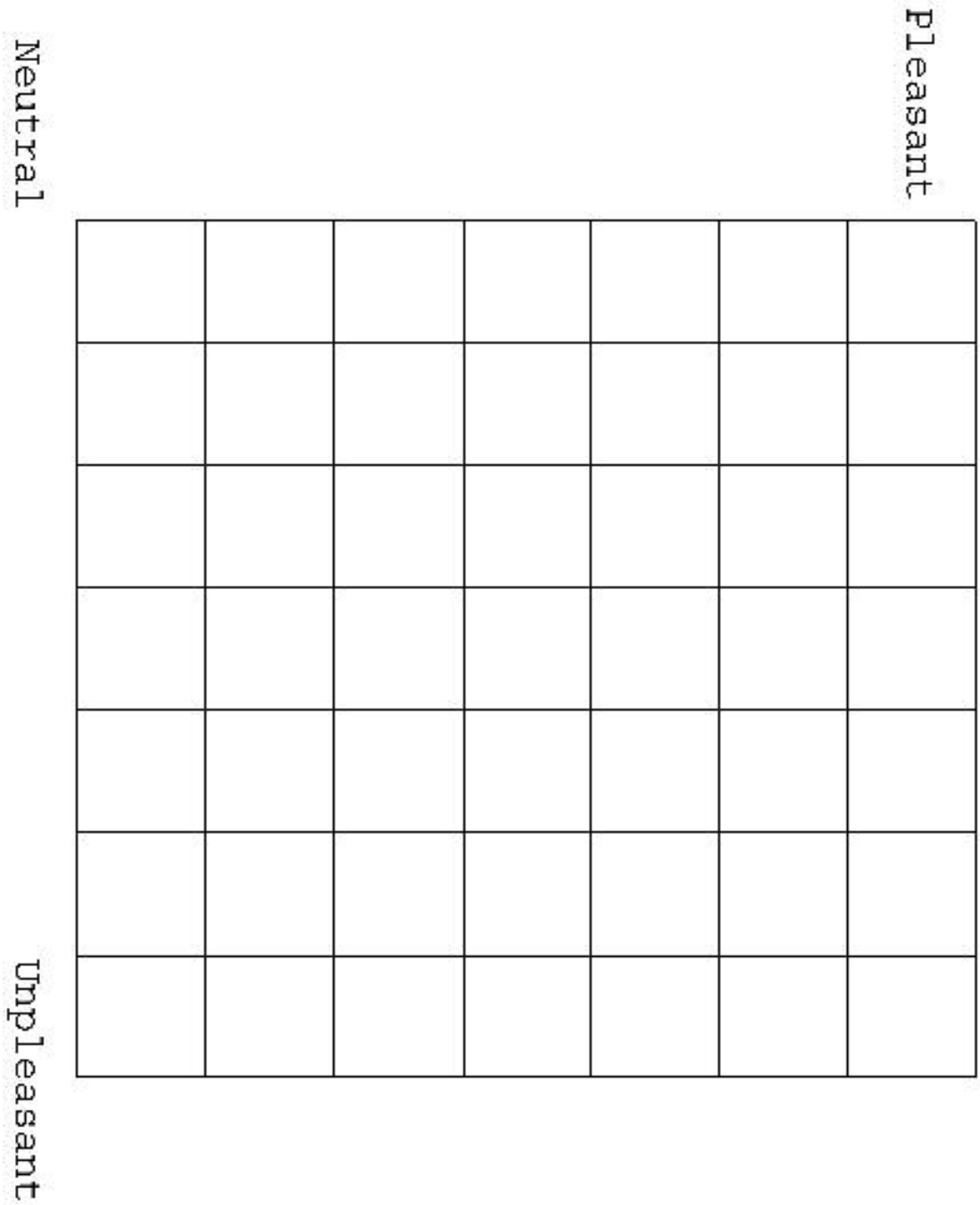

Figure 3: Neckar Cube

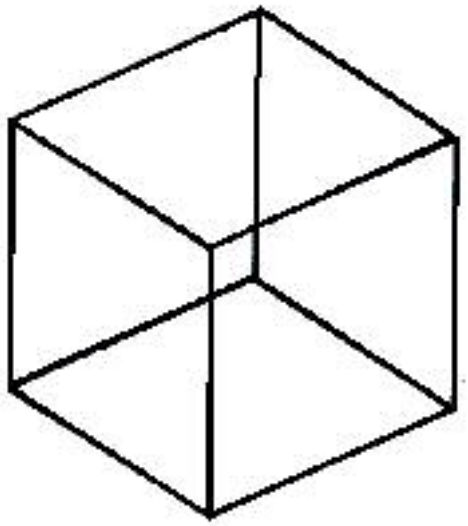

Figure 4: Measurement grid with low tolerance for pleasantness and unpleasantness

6	0,Y	M	M	M	M	M	M
5	0,Y	M	M	M	M	M	M
4	0,Y	M	M	M	M	M	M
3	0,Y	M	M	M	M	M	M
2	0,Y	M	M	M	M	M	M
1	0,Y	M	M	M	M	M	M
0	0,0	X,0	X,0	X,0	X,0	X,0	X,0
	0	**1**	**2**	**3**	**4**	**5**	**6**

Figure 5: Measurement grid with higher tolerance for pleasantness and unpleasantness

6	0,Y	1,Y	M	M	M	M	M
5	0,Y	1,Y	M	M	M	M	M
4	0,Y	1,Y	M	M	M	M	M
3	0,Y	1,Y	M	M	M	M	M
2	0,Y	1,Y	M	M	M	M	M
1	0,Y	1,1	X,1	X,1	X,1	X,1	X,1
0	0,0	X,0	X,0	X,0	X,0	X,0	X,0
	0	1	2	3	4	5	6

Table 1: All data by block

	N	H	F	MH	MF
Neut	25.7	21.9	23.4	21.2	27.4
1,1	3.9	2.7	5.3	3.9	2.6
X,0	7.1	7.5	5.9	6.6	8.7
X,1	5.8	8.3	4.7	2.8	5.1
0,Y	26.4	23.6	24.3	29.3	18.1
1,Y	11.7	10.7	11.4	13.0	10.4
Mixed	19.5	25.3	25.0	23.2	27.8
	100	100	100	100	100

Table 2: Percentage of positive and negative responses for happy and fearful blocks (low and higher tolerance)

	H	F
X, 0	7.5	5.9
0, Y	23.6	24.3
X, 0 and X, 1	15.8	14.6
0, Y and 1, Y	34.3	35.7

Table 3: Mean ratings for pleasantness of faces

Happy faces (H)	2.67
Fearful faces (F)	-3.02
Neutral faces (N)	-1.31
JACFEE neutral faces (JN)	0.59

Table 4: Statistical significance of ratings

	H	F	N	JN
H	--	--	--	--
F	$p < .01$	--	--	--
N	$p < .01$	not sig	--	--
JN	$p < .05$	$p < .01$	not sig	--

Table 5: Data by block for low tolerance

	N	H	F	MH	MF
Neut	25.7	21.9	23.4	21.2	27.4
Pos/Neg	33.4	31.1	30.1	35.9	26.8
Mixed	40.9	46.9	46.5	42.9	45.8
	100	100	100	100	100

Table 6: Data by block for higher tolerance

	N	H	F	MH	MF
Neut	25.7	21.9	23.4	21.2	27.4
Pos/Neg	54.8	52.8	51.6	55.5	44.8
Mixed	19.5	25.3	25.0	23.2	27.8
	100	100	100	100	100

Table 7: All data by session

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
Neut	17.7	16.6	23.8	26.7	25.8	23.9	22.4	32.9
1,1	3.2	2.3	4.0	3.0	3.0	6.7	3.7	4.8
X,0	8.1	8.0	6.8	5.8	7.7	7.7	5.9	6.1
X,1	3.7	2.5	6.9	2.9	7.7	8.1	8.4	5.6
0,Y	31.0	27.5	26.6	24.2	19.2	20.5	25.0	23.3
1,Y	16.1	13.7	10.4	10.8	11.3	7.0	11.9	9.3
Mixed	20.2	29.4	21.4	26.6	25.4	26.1	22.9	18.0
	100	100	100	100	100	100	100	100

Appendix A: Training Scenarios

Graduation Day – Scenario 1

Imagine that it is your graduation day. You have been waiting for this day for a long time. You think back to the anxiety of your first day of college. You were scared and became of unsure of your decision to go to college at all. When you parents left you, you felt alone and deserted. You just wanted to be back in the safety of your home. But now, four years later, you are a confident senior. You got invited to all the best parties and had many good times. You were able to take the best classes with the best professors. As you put on your cap and gown, you feel like a great success. Your roommates and your best friends are ready, and together you leave for the ceremony. You've been dreading the ceremony. And your concerns were not unfounded. The speaker is boring and the ceremony drags on. But now, as they are reading off the names the anticipation builds. Yours is next. As they read your name a rush goes over you. Your turn back and see your parents proudly clapping. You're happy to be a success in their eyes. As the dean firmly shakes your hand, you feel elated. Then as you retake your seat, a new rush comes over you. You are once again uncertain. You've come so far in college, but now you must start again in the real world. The economy is bad and you don't yet have a job. You don't want to live at home, but you can't afford to live anywhere else. You are worried about your future. You break out of this horrible daydream as your friend's name is read. You're so happy that they made it, but at the same time you can't shake your own apprehension. This is truly a bittersweet moment. You give one last thought to the difficult road you must now navigate, but then feel pure joy as the ceremony concludes and you throw your cap into the pure, blue sky. You made it!

Move Out Day – Scenario 2

Picture that it is the last day of your junior year. As your phone rings, you hear your mom on the other line, she is downstairs. You can't wait to see her. You have not seen your parents since Easter break. As you meet them at the door, you see their smiling faces and give your dad a hug. As you return to you room, you realize that you have a ton of stuff to move out. It's not going to be fun making all those trips up and down the stairs in the sweltering heat. At least school is over though. Finals were long and difficult. You finished your last one this morning. You're sure that you bombed it. You can't believe how difficult it was. You're not looking forward to seeing your final grade. But right now you're relieved. The stress of school is over for at least a few months. Meanwhile, your roommate has finished packing and is walking out the door. You say goodbye and know that you'll miss him/her. You had a really fun year together. You regret that you live across the country from him/her, and probably won't see him/her all summer. After the packing is complete, you get into the car. That's one more year that you've finished. When you come back to school, you will finally be a senior. In a way, you can't wait for next year to begin. It should be a blast. First you have a tortuous 6 hour car trip ahead of you. You're cramped in the back seat along with text books and clothes. Your parents turn on their favorite radio station. You can't stand it. You think

to yourself “are we there yet?” You don’t know how you’ll survive the summer living with them. But then you think of all your friends at home. You can’t wait to see them. The summer should be a fun one. You turn around and take one last look at your dorm. You know that once the car pulls away, all of your memories of junior year will be the past. They were both good and bad, but now you must move on.

Breaking Up – Scenario 3

It was a call that you knew was coming for months. Your boyfriend/girlfriend dumped you. You had considered making the call yourself numerous times. You also had wanted to break up with him/her. But what gets you is how he/she did it. What a jerk. You can’t believe he/she said all those nasty things about you. But you do like the result. You didn’t really want to be going out with him/her anymore. So you are relieved. But at the same time it still feels strange. You guys seemed like the perfect couple for over two years, until things recently took a turn for the worse. You like to remember the good times and all the fond memories you share. You guys had so much in common. You could always find a way to have fun together. Being single again is not how you felt it would be. Part of you wants to cry, but another part of you just wants to let loose and laugh. You wonder what will happen to you now. Will you ever find someone again, or will you be alone for the rest of your life? Maybe yes, maybe no. You can’t decide, you’re unsure. But at the same time a burden has been lifted from you. You knew this had to happen eventually, so it was good just to get it over with. Things had progressed to the point where they would never be the same again. As bad as that sounds you know it is true. The phone rings again. A rush comes over you. Is it him/her calling you back? Do they want to get back together? But it is only your friends. They’re inviting you to a party, you think you’ll go. Who knows, you may even meet someone there you like. You have a new freedom you haven’t known for a long time.

Appendix B: Color-coded Affect Grid