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Integration of audio-~visual emotional information in schizophrneia

Bern Lee
University of Nevada, Las Vegas

INTEGRATION OF AUDIO-VISUAL EMOTIONAL INFORMATION

IN SCHIZOPHRENIA

By

Bern Guthrie Lee

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Bern Lee

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Master of Arts – Psychology
Department of Psychology

Daniel Allen, Ph.D.
Examination Committee Chair

Stephen Benning, Ph.D.
Examination Committee Member

Joel Snyder, Ph.D.
Examination Committee Member

Merrill Landers, D.P.T., Ph.D.
Graduate College Faculty Representative

Kathryn Hausbeck Korgan, Ph.D.
Graduate College Interim Dean

Abstract

Schizophrenia (SZ) is a debilitating illness characterized by a number of perceptual and cognitive deficits. Deficits in emotional judgment and perception are consistently identified, although less is known about the integration of emotional information from separate sensory modalities. This study investigates the integration of auditory and visual emotional information in schizophrenia and healthy controls through application of an emotion judgment task modeled after the McGurk effect. The emotional judgments of 54 participants (40 SZ and 14 control participants from the community) for auditory, visual, and bimodal phonemic stimuli conveying no lexical information were analyzed. Visual and auditory stimuli conveying joy or sadness were presented either alone, in congruent audiovisual form (e.g., joyous audio/joyous video), or as incongruent audiovisual (e.g., joyous video/sad audio) stimuli. It was hypothesized that for incongruent bimodal stimuli, controls would demonstrate a predictable shift into an emotional category that represented neither of the original emotional expressions, and that persons with schizophrenia would perform more poorly on this task, most notably for auditory productions of sadness. Results indicate that persons with schizophrenia are worse than controls at accurately judging auditory sadness, and that when presented with incongruent stimuli they judge the emotion presented by the visual signal more frequently than control participants. These results shed light on observed deficits in social and emotional judgments in schizophrenia, most notably those requiring integration of sensory information.

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Chapter 1

Literature Review

One of the most basic tasks in communication is perception of human emotion. This perception may be as simple as recognizing joy in the smile of another, or as complex as correctly reading irony or sarcasm. Within our milieu, these tasks are important for many daily social interactions. It is therefore unsurprising that for over 50 years, studies have focused on human emotion perception. Such research has demonstrated a set of facial expressions that convey basic human emotions that are interpretable across cultures (e.g., Ekman, 1993, 1994; Ekman et al., 1987; Ekman & Friesen, 1971; Tomkins & McCarter, 1964) even for those with very minimal exposure to western culture. Ekman and colleagues (Boucher & Ekman, 1975; Ekman & Friesen, 1975, 1976; Ekman, Friesen, & Tomkins, 1971; Ekman et al., 1987) have repeatedly found that standardized pictures of faces portraying six basic emotions (happiness, surprise, fear, anger, sadness, and disgust) and neutrality were accurately perceived by students from 10 nations, with sadness and happiness being the most accurately identified. Successful judgment of these emotions was achieved by analysis of the facial configurations of the brow, eyes, and mouth.

Certain acoustic parameters have also been identified as critical to distinguishing between auditory expressions of emotions, including voice quality and utterance timing, and frequency (F_0) dynamics such as amplitude, and jitter and shimmer, referred to as F_0 micro-dynamics (Banse & Scherer, 1996; Costanzo, Markel, & Costanzo, 1969; Davitz, 1964; Murray & Arnott, 1993; Russell, Bachorowski, & Fernandez-Dols, 2003; Scherer, 1986, 1988; Sobin & Alpert, 1999; Williams & Stevens, 1972).

While auditory and visual expressions of emotion have been investigated in isolation, until recently, relatively few studies have examined the integration of auditory and visual information from another person in the perception of emotion. This lack of investigation is remarkable in that successful appraisal of emotion in vivo often requires such integration. Thus, this study serves to elucidate the nature of this emotion integration in healthy individuals and examine it in individuals diagnosed with schizophrenia, who as a group have been identified to have deficits in emotion perception.

An intriguing effect known as the McGurk effect (MacDonald & McGurk, 1978; McGurk & MacDonald, 1976) demonstrates that visual information can demonstrably influence auditory speech perception. When an auditory production (e.g., /aba/) is dubbed onto a dynamic visual signal of a face producing a consonant that reflects a different place of articulation (/aga/), perceivers typically report hearing a predictable consonant that matches neither source (e.g., /ada/). This effect is a captivating one which demonstrates the perceptual integration of auditory and visual speech. The McGurk effect is highly replicable across wide age spans, is experienced by approximately 80% of the population, and occurs equally as often in adults and pre-linguistic English-exposed infants as young as five months old whose focus is limited to the mouth of the speaker (Kuhl & Meltzoff, 1982; Rosenblum, Schmuckler, & Johnson, 1997). The effect is also present over a range of languages and cultures (Hardison, 1996; Sams, Manninen, Surakka, Helin, & Kaettoe, 1998; Sekiyama & Tohkura, 1991; Sekiyama, 1997a; Sekiyama, 1997b). Studies with these diverse populations suggest that the tendency to integrate auditory and visual sources of information represents a basic human perceptual process.

In light of evidence for the integration of auditory and visual information in phoneme perception, it could be anticipated that likewise there should be bimodal integration of other accompanying communicative information in the speech signal, such as auditory and visual cues to emotion. A number of studies have examined the integration of auditory and visual cues to emotion (e.g., see de Gelder & Vroomen, 2000; Massaro, 1998). Early studies concluded either that emotional information conveyed by the face or voice do not interact or, if there is an interaction, that the facial information has a substantially stronger influence on the perceived emotion than does the vocal information (e.g., Andersen, Tiippana, Laarni, Kojo, & Sams, 2009; Gates, 1927; Hess, Scherer, & Kappas, 1988; Levitt, 1964; Mehrabian & Ferris, 1967). According to the latter view, however, visual dominance may decrease as the auditory and visual channels become less congruent (e.g., positive-dominant auditory and negative-submissive visual; DePaulo et al., 1978).

More recent studies examining the bimodal perception of emotion have provided clear evidence for perceptual interactions between auditory and visual affect (Collignon et al., 2008; de Gelder & Vroomen, 2000; Massaro, 1998; Massaro & Egan, 1996). There is evidence for auditory cortex involvement in the integration of bimodal auditory and visual stimuli, such that it is thought to process information presented in the visual modality (Luo et al., 2010). In a series of three studies, Massaro (1998) combined computer-generated faces with natural voice recordings of an emotionally neutral word ("please") produced with either congruent (e.g., happy face, happy voice) or incongruent (e.g., happy face, sad voice) affect. Isolated voice (auditory only) and face (visual only) stimuli also were presented as unimodal control conditions. Across studies, participants judged stimuli to match the intended emotion significantly more often in auditory, visual, and bimodal congruent conditions than in bimodal incongruent conditions. The perception that the incongruent stimuli did not match one of the original emotional categories (happy or sad), suggests that information from the auditory and visual sources was integrated.

Although explicitly directed to only attend to either the auditory or visual source, participants were unable to ignore the other source of information. de Gelder and Vroomen (2000) obtained similar effects of bimodal (in)congruence and source-specific attention from three experiments by combining photographs of faces depicting sadness or happiness (or fear or happiness) with sentences reflecting emotionally neutral content spoken in either a sad or happy (or fearful or happy) manner. Thus, the results of these studies, using markedly different methodologies, provide converging evidence for the perceptual interaction between auditory and visual information during emotion perception.

For the large body of research on emotion perception in healthy controls, there is further research examining these emotional constructs in persons with schizophrenia. Schizophrenia is a debilitating disorder; a primary feature of which are emotional deficits that cut across its' highly heterogeneous symptom presentation. It has been shown that people with schizophrenia are less accurate than are healthy controls at judging emotion in static faces (Johnson et al., 2001; Kohler et al., 2010; Lee et al., 2010; Shin et al., 2008) and also in regulating emotional response to negative stimuli (Strauss et al., 2012; 2013). Further, in a recent meta-analytic review, Kohler et al. (2010) demonstrated that such facial emotion-judgment deficits exist across a wide variety of tasks. These deficits are thought to be related to an abnormal neural response to facial stimuli (Kosaka et al., 2002). Proposed neural correlates of abnormal response to emotional facial stimuli are in diverse brain regions, although most consistently the amygdala (Kosaka et al., 2002; Lepage et al., 2011; Phillips et al., 1999) and parahippocampal region bilaterally (Lepage et al., 2011). Although some evidence points to a sparing in the appraisal of negative evolutionarily salient emotional expression such as fear and anger (Mandal et al., 1998), emotion processing deficits have been consistently observed since the inception of emotional judgment research in schizophrenia.

Beyond deficits in the evaluation of emotional visual stimuli, schizophrenia patients frequently display auditory processing deficits (Javitt et al., 2000; Simosky et al., 2003; Weintraub et al., 2012) and further these deficits extend to the judgment of emotional information presented vocally (Gold et al., 2012; Leitman et al., 2010), a highly important judgment. Given evidence for auditory cortex dysfunction in schizophrenia (Perez et al., 2012; Stevens et al., 1998), integration of auditory visual emotional information may be uniquely impaired. Indeed, recent evidence (Sestito et al., 2013) suggests that for persons with schizophrenia, visual information from faces may supersede auditory input.

Gold et al. (2012) found that not only do persons with schizophrenia experience deficits in auditory emotion recognition, but also that these deficits may be related to their perception of underlying acoustic features. Auditory stream segregation tasks represent a generalizable method of investigating impairments in the auditory system, and may relate to the ability to differentiate similar auditory stimuli that occur in one's environment. Auditory stream segregation occurs when a person perceives two or more repeating sounds that differ in at least one acoustic attribute as two or more separate sound sources, or 'streams' (Snyder & Alain, 2007). Studies on such tasks have shown that persons with schizophrenia fail to perceive such streams when differing sounds are significantly more discrepant in pitch, amplitude modulation rate, and inter-aural time difference than when healthy controls fail to perceive individual streams (Ramage et al., 2012; Weintraub et al., 2012). Taken together, there is clear evidence for auditory deficits in the perception of basic aspects of pitch, frequency, and amplitude among those with schizophrenia, and these deficits extend to natural productions of speech conveying emotional information.

Although these findings present a consistent picture in schizophrenia, there remains a lack of ecologically valid stimuli that integrate auditory and visual information in such studies. What research does exist often relies on static images, where video presentation may offer more generalizable results. Dynamic image research rarely uses audio-visual human facial stimuli not constructed via computer animation. Though an argument can be made for the internal validity of such computer-generated paradigms, it is important to extend such research to avenues with greater external validity. Additionally, auditory stimuli in these paradigms most frequently depend upon salient lexical cues to convey emotion rather than less obvious aspects of vocal inflection equally important to emotional perception in vivo. Further, studies allowing persons with schizophrenia to select from a range of affective response options are a rarity, as the field is so often interested in accuracy without focusing on the patterns of inaccurate response. Thus, it remains unclear whether the combination of incongruent auditory visual emotional stimuli produce a reliable shift away from the intended emotional category based on the visual and acoustic features of the stimuli, or simply represent alternative responses to otherwise ambiguous emotional stimuli.

There is a clearly demonstrated interplay between visual and auditory information on affect, and it is evident that deficits in both visual processing and auditory processing exist in persons with schizophrenia; a disorder characterized in part by emotional abnormality. Following from this body of research, evidence for an integration of visual and auditory emotion using ecologically valid stimuli has come to light (Fagel, 2006; Forrest, 2002) in the healthy population. In one such study, Forrest (2002), presented audio-visual dynamic facial stimuli conveying either sadness or joy. These stimuli were presented in congruent and incongruent bimodal audio-visual fashion. When asked to judge the vocal expression of emotion in bimodal incongruent stimuli consistent of a sad voice and a happy face, participants frequently judged stimuli to represent the emotion of acceptance. On the other hand, when a happy voice was paired with a sad face, participants frequently judged the stimuli to represent the emotion of anger. Adequate examination of auditory and visual stimuli in making emotional judgment is important because it provides crucial information regarding the manner in which emotional information from multiple sources is integrated to produce emotion perception. Though initial research seems to have demonstrated such interplay, there are conflicting results (see Massaro, 1998) in light of which further investigation is warranted.

This study serves to address the methodological concerns raised for use of limited emotional response options (i.e., that such limitation prevents the observation of a perceptual shift outside original emotional category) and provides externally valid information about the integration of auditory and visual emotion perception. For the purposes of this paper, perceptual shift occurs when the auditory stimulus is presented with a visual stimulus depicting an incongruent emotion (e.g., happy auditory, sad visual) and the auditory stimulus is no longer rated as its intended emotion (i.e. happy) but as another emotion. Importantly, we will investigate the nature of the emotional response in persons with schizophrenia to ecologically valid stimuli presented in bi-modal fashion. Most interestingly, perhaps, this study examines the relationship between patterns of inaccurate responses to emotionally incongruent stimuli and the diagnosis of schizophrenia.

Based upon the extant literature, a number of hypotheses were made. First, it was hypothesized that persons with schizophrenia will demonstrate lower overall accuracy levels when compared to healthy controls for both unimodal and bimodal congruent emotional stimuli, and that these deficits would be most pronounced in the judgment of sadness. A well-established observation in the literature is that persons with schizophrenia show deficits in facial emotion recognition, most significantly for negative emotions (de Gelder et al., 2013), excepting anger.

Second, it was hypothesized that for both schizophrenia and control participants there would be an increased frequency of ratings of emotional categories that do not reflect one of the two original auditory emotional expressions when bimodal incongruent stimuli are presented. Previous work with this stimulus set (Forrest, 2002) has shown that when making judgments about incongruent bimodal stimuli, participants shifted their judgments away from the intended emotional category.

Third, for individuals with schizophrenia, it was hypothesized that the shift away from the intended emotional category would be less consistent than for controls. In the Forrest (2002) study, healthy controls demonstrated a predictable shift to an emotional category that represented neither original auditory emotional expression. Though this may hold true for healthy controls, given evidence for visual information bias in schizophrenia (Sestito et al., 2013), recognized auditory deficits in schizophrenia (Perez et al., 2012; Stevens et al., 1998), and the evidence for visual processing in the auditory cortex (Luo et al., 2010), it was anticipated that perceptual shift away from either intended emotional category would be less consistent for persons with schizophrenia.

Chapter 2

Methods

Participants

Participants included 51 persons with schizophrenia (SZ) and 15 healthy controls (CN). More SZ participants were recruited to accommodate the likelihood of higher within-group variability. This unequal distribution of participants risks violating the assumptions of some of our analyses. Unequal sample size in MANOVA causes ambiguity regarding the assignment of sums of squares to groups, and to the marginal mean (Tabachnik & Fidell, 2007). Fortunately, the corrections suggested by Tabachnik and Fidell (2007) are performed by default in SPSS: the statistical program used for all analyses. Subjects ranged in age from 20 to 67, and participated in the current experiment for pay at a rate of 10 dollars per hour. All participants were native speakers of American English, had normal or corrected to normal vision, and reported no hearing deficits, neurological conditions, or other medical disorders that might influence perception of auditory and visual information.

All participants were interviewed using the Structured Clinical Interview for the DSM-IV (SCID; First et al., 2001) by a doctoral student extensively trained in the valid and reliable administration of the SCID. Participants were excluded who met diagnostic criteria for a substance use disorder within the last six months, had a current Axis I diagnosis other than schizophrenia, had a diagnosis of mental retardation, or used medications that could produce significant cognitive effects (other than those for treatment of schizophrenia) as indicated by the SCID, self-report, and available medical records. SZ participants were recruited from a community outpatient center in the Las Vegas area. Those recruited had a clinical diagnosis of schizophrenia made by their treating psychiatrist. Research consensus diagnoses were established using information from the SCID, review of medical records, and consultation with psychiatric staff involved in the treatment of the individual. Control participants recruited from the community were screened identically, and did not meet lifetime diagnostic criteria for a psychotic disorder. All subjects were provided informed consent prior to participating in the current study.

Apparatus and Materials

Stimuli. Stimuli were auditory only, visual only, and integrated audio-visual disyllabic utterances previously validated in a study of students from a southwestern university (Forrest, 2002). The stimulus set is comprised of natural utterances from an adult female native speaker of American English with acting experience. A female actor was used because female productions of happiness (Becker et al., 2007) and sadness (Palermo & Coltheart, 2004) are more accurately judged than are male productions. Stimuli conveyed (both auditorily and visually) a sad or joyous emotion while producing a particular /a/-[consonant]-/a/ phonemic cluster which varied with respect to place of articulation of the consonant [/b/ (bilabial) or /g/ (velar)]. This place of articulation change was included to provide a natural range of variation across auditory and visual stimuli while using phonetic categories like those that are typically used in studies of auditory-visual speech integration. Sad and joyous emotional categories were used because participants judged these opposite emotional categories most accurately during validation.

Eight auditory-only and four visual-only stimuli were used. Auditory only stimuli represented a combination of intended emotion (joy or sadness) and a particular consonant (/b/ or /g/) cluster, using two exemplars for each emotion. Visual only stimuli were a combination of emotion (joy or sadness) for the best identified phoneme cluster (/b/) with two exemplars of each emotion. Stimuli were chosen that were judged to be the best exemplars of the intended emotion during the initial study of these stimuli (Forrest, 2002). Visual only ‘aga’ phoneme clusters were not used for visual only stimuli, as they were infrequently identified as the intended emotion. Auditory-visual stimuli were frame-matched combinations of four auditory only and four visual only stimuli presented both congruently (e.g., auditory joy with visual joy) and incongruently (e.g., auditory joy with visual sadness or visa versa) representing all possible combinations of each of our four video only stimuli with the four best exemplar audio-only stimuli, and thus includes 16 utterances.

Each utterance was recorded on a Panasonic AG-456 camera and Sennheiser MD735 microphone simultaneously, and all were recorded within a single session. The 10 clearest recordings for each phoneme and emotion condition were chosen by consensus among the authors of the original study. All chosen stimuli were then digitized (the video at a rate of 1,000 Kbps and the audio at 44.1kHz in 16 bit stereo). All stimuli were standardized to a length of two seconds. Each 2-second visual stimulus was linearly ramped on from black over the first six frames, and off to black over the final six frames. The auditory stimuli (excised and saved separately from their visual counterparts) were equated for maximum amplitude without peak clipping, and converted from stereo to monaural signals to allow for binaural presentation, and were submitted to an idealized digital 90 Hz high-pass filter to eliminate background noise associated with electrical currents at the time of recording. Auditory stimuli were low-pass filtered at 5 kHz (Butterworth filter with a -12 dB/octave skirt) for anti-aliasing purposes at presentation. Auditory stimuli were delivered at a comfortable (approximately 80 dB) volume via Sennheiser HD 25-headphones. Visual stimuli were output to a 19" monitor as .avi files using the Indeo 3.2 compression codec at maximum quality and a fixed data throughput rate of 1000 Kbps.

Procedure. Using these stimuli, each of 66 participants completed three modality conditions: auditory-only, visual-only, and auditory-visual. Tasks were blocked by modality condition such that the auditory-only and visual-only stimuli were counterbalanced and both presented before the combined auditory-visual stimuli, which were always presented as a third block. For auditory-visual stimuli, participants were instructed to look at the face, listen to the voice, and determine the emotion expressed by the voice. Prior to each task, participants were familiarized with that task's modality stimuli by presenting each of the stimuli from the subsequent block of trials once in random order, each separated by a 1,000 ms delay. Participants could repeat this familiarization before continuing with the task.

The familiarization period for a given task was immediately followed by a corresponding set of experimental trials. Each experimental trial began with a 500 ms inter-trial-interval, which was followed by a stimulus reflecting a particular emotion. Participants were asked to indicate the emotional expression in the stimulus from four categories from the second level of Plutchik's revised (1980) circular model of eight primary emotions: acceptance, anger, disgust, expectancy, fear, joy, sadness, or surprise, and a neutral response option. Of these eight acceptance, joy, anger, and sadness were used. Fewer response options were desired in order to reduce task difficulty. Therefore, an empirically supported model for emotional choice (Fromme & O'Brien, 1982; Havlena, Holbrook, & Lehmann, 1989; Osgood, 1966) using these five response options was used. Participants indicated their response by using the mouse to select an emotion option displayed on the computer screen. Participants were also asked to select via mouse click the phonemic utterance presented in the preceding trial from a list comprised of the two expressed phonemic clusters (aba and aga) and two distractor phonemes never articulated during the experiment (ada and abga). Music Experiment Development System (MEDS 99-C; Kendall, 2002) managed stimulus presentation, data collection, and summary output.

Each of the auditory-only tasks consisted of 24 trials, encompassing the randomized presentation of each unique stimulus a total of three times. Visual-only tasks consisted of 12 experimental trials (each expression of joy and sadness presented randomly three times). In both tasks, participants judged stimuli from the given modality with respect to the category of the conveyed emotion, and the phonemic presentation. Brief rest breaks were given after a condition was completed if requested. Participants were asked to select the emotion to which the auditory or visual stimuli corresponded from the five emotion categories.

The final task (block 3) consisted of auditory-visual stimuli, presented both as emotionally congruent and emotionally incongruent, each of which occurred with a probability of 0.5. There was one block of 32 randomized trials, including two presentations of each intended auditory and visual affect (auditory joy with visual joy, auditory joy with visual sadness, auditory sadness with visual sadness, and auditory sadness with visual joy) combined with each variation in phonemic articulation. Participants were instructed to classify the perceived auditory emotion while observing the accompanying visual production, as is done in studies of the McGurk effect.

Testing took place in a quiet room free of distractions, and the task was administered as a part of a larger battery of measures. Detailed demographic information and medication information were taken for all participants, and IQ estimates were obtained by administration of a WAIS-III short form (Block Design, Vocabulary, and Information) validated for estimating IQ in individuals with severe mental illnesses (Ringe et al., 2002). For participants with schizophrenia, symptom ratings were collected using the Scale for the Assessment of Negative

Symptoms (SANS; Andreasen, 1983), the Scale for the assessment of Positive Symptoms (SAPS; Andreasen, 2004), and the Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962). A doctoral student extensively trained in the valid and reliable administration of all tasks conducted the evaluations.

Statistical Analyses and Expected Results

To test the first hypothesis, differences in the ability of our SZ and CN participants to complete the task, this study examined accuracy between SZ and CN for phoneme cluster identification (i.e. how accurately each group identifies 'aga' as 'aga' rather than 'abda' or 'aga'). It was expected that persons with schizophrenia would perform more poorly than healthy controls on this task given well-understood auditory processing deficits; though to demonstrate that participants attended to task parameters, all participants scoring below 80% across phoneme identification trials were removed from analyses. Removing those scoring less than 80% ensures that comparisons reflect emotional judgments rather than failure to attend to task parameters. Further, given that more than one phoneme cluster was used to increase variety within the experiment and allow for greater generalizability of results, 'aga' and 'aba' phoneme responses were collapsed.

A mixed model ANOVA was used to evaluate the first hypothesis concerning differences in accuracy of emotion judgment between the SZ and CN groups. The ANOVA included one between subjects factor Group (SZ and CN), one within subjects Emotion factor consisting of correct responses to the two intended emotion categories (joy, sadness), and one within subjects Stimuli factor (auditory, visual, bimodal congruent). Given the body of research discussed which points to emotional judgment deficits in persons with schizophrenia, it was hypothesized that there would be significant differences in emotion judgment accuracy between people with schizophrenia and healthy controls, with SZ being less accurate than CN.

For the purposes of this study, perceptual shift occurs when the auditory stimulus is presented with a visual stimulus depicting an incongruent emotion (e.g., joyous auditory, sad visual) and the auditory stimulus is no longer rated as its intended emotion (joyous) but as another emotion. Thus, to evaluate hypotheses 2 and 3, concerning perceptual shift out of intended emotional category for incongruent bimodal emotional stimuli, a series of analyses will be conducted. First, to examine whether there was a different distribution of emotional ratings (acceptance, joy, anger, sadness, or neutral) between the groups (SZ and CN) for the emotional targets (sad and joyous) based on whether the stimuli were Audiovisual (AV) Incongruent or Audio Only (AO), a 2 between-group (SZ and CN) by 2 within-subjects (joy or sad auditory emotional stimulus) by 5 within-subjects (acceptance/ joy/ anger/ sadness/ neutral; emotional ratings) by 2 within-subjects (AV Incongruent or AO) repeated measures mixed model ANOVA was used to examine potential differences between groups in the distribution of emotional ratings. A 4 way interaction effect was anticipated that indicates the CN group emotional ratings shifted out of the intended emotional category in response to sad or joyous AV Incongruent stimuli, while individuals with SZ would not demonstrate as consistent of a shift. The interaction effect was followed up by conducting the repeated measures ANOVAs described above in the SZ and CN groups separately.

A series of paired samples *t* tests was conducted to explicate whether the expected patterns of results for hypothesis 2 and 3 are supported. To test whether the interaction effect indicates a shift out of the emotional condition for AV incongruent stimuli, paired samples *t* tests comparing a) frequency of responses to the auditorily presented emotion between AO joy and the joy voice/sad video AV incongruent condition and b) frequency of responses to the auditorily presented emotion between the AO sad and the sad voice/joy video AV incongruent condition were conducted for each group (CN/ SZ). The hypothesis would be supported if the AV incongruent stimuli were less often rated as the auditory emotion than AO stimuli.

Finally, for the significant AO vs. AV incongruent shifts, we conducted paired samples *t* tests between the frequency of responses between AO and AV incongruent conditions for all emotion conditions. These analyses examined to what emotions participants shift when they shift out of the intended emotion. A shift into emotion would be supported if the stimuli are consistently rated more often as another emotion for AV incongruent than AO conditions. For all of these analyses, percent responses were used to represent frequency to equate for the unequal number of trials across conditions. It was expected that both groups would exhibit a shift out of intended emotional categories of joy and sadness for AV incongruent stimuli, as indicated by endorsing emotion response options of acceptance or anger (hypothesis 2). It was also expected that the CN group would endorse either acceptance (sad voice/happy face) or anger (happy face/sad voice) more frequently than other response options, but this pattern would not be found for the SZ group (hypothesis 3).

Chapter 3

Results

Eleven participants with schizophrenia and one healthy control participant who did not score at or above 80% on phoneme identification were removed, and analyses were conducted on the remaining 54 participants (14 CN, 40 SZ). The data were considered normally distributed for all variables based on skewness and kurtosis estimates that were within acceptable limits of < 1 and < 1.5, respectively. An ANOVA for phoneme accuracy indicated no significant differences between CN and SZ participants for visual phoneme identification or collapsed auditory phoneme condition ($p > .05$ for both). Given these findings, phoneme accuracy was not used as a covariate for further analyses.

Demographic and symptom data were examined for all participants (see Table 1). Participants with schizophrenia were significantly older (F1, 52 = 4.89, $p < .05$), had lower estimated full-scale IQ ($F(1,52) = 27.19$, $p < .001$), were less educated ($F(1,52) = 4.98$, $p < .05$), and had significantly lower Hollingshead Index scores ($F(1,49) = 18.14$, $p < .01$) than healthy controls. Hollingshead index data could not be calculated for two HC and 1 SZ participant who did not report employment data. Chi square analyses indicated significant differences in the distribution of ethnicity ($\chi^2(5) = 15.26$, $p < .01$) and gender ($\chi^2(1) = 4.10$, $p = .043$) between groups. Given age differences, correlations were run between age and accuracy scores for auditory, visual, and AV congruent emotion conditions for auditory joy and auditory sadness for SZ and CN groups. There were no significant correlations between age and accuracy for any conditions in either group. Due to gender differences between groups, one-way ANOVA was used to compare accuracy for auditory, visual, and AV congruent emotion conditions for auditory joy and sadness as a function of gender. When corrected for multiple comparisons via the the method suggested by Benjamini and Hochberg (1995), there were no significant differences in accuracy as a function of gender for any condition. We did not control for differences in education, Hollingshead index, and IQ because given the prevalence of lower IQ and socioeconomic status in SZ, controlling for these differences is likely to statistically control for the disorder itself.

To examine hypothesis one, a mixed model ANOVA of accuracy for Group (SZ and CN) by Target emotion (joy, sadness) by Stimuli (auditory, visual, bimodal congruent) was conducted (See Figure 1). The ANOVA revealed a significant main effect for Stimuli ($F(2, 51) = 51.91$, $p < .001$) such that auditory stimuli were judged less accurately than other conditions. There was a significant Group by Target interaction effect ($F(2, 52) = 9.66$, $p < .01$), such that SZ and CN were similarly accurate for judgments of joyous stimuli, though SZ were less accurate than CN for judgments of sad stimuli. There was a significant Stimuli by Target interaction effect ($F(2, 51) = 7.80$, $p = .001$) caused by similar accuracy for AO sadness and AO joy conditions, while all other modalities showed better performance for joy. Interestingly, this was driven wholly by CN performance, as paired samples *t* tests reveal that SZ had poorer performance on AO sadness than joy ($t(13) = -3.53$ $p < .01$), while CN showed the inverse for AO conditions, although this relationship was non-significant ($t(39) = 1.98$; $p = .055$). Nevertheless, the overall interaction effect (Stimuli x Target x Group) was not significant ($F(2, 51) = 1.83$, $p = .17$).

Figures 2, 3, and 4 further present accuracy data for unimodal emotional stimuli (Figure 2), bimodal emotional stimuli (Figure 3), and phoneme stimuli (Figure 4). As can be seen from Figure 2, CN and SZ were similarly accurate for visual only and auditory only expressions of joy, while SZ was less accurate for auditory and visual expressions of sadness. Figure 3 indicates that while SZ and CN were similarly accurate for AV congruent expressions of joy, SZ were less accurate than CN for AV congruent expressions of sadness, as well as AV incongruent expressions of both auditory joy and sadness. Figure 4 demonstrates that the SZ and CN groups had similar accuracy for phoneme conditions, which were examined to ensure that both groups understood that task parameters and were attending to the stimuli.

To examine hypotheses two and three, a series of analyses were conducted. First, a 2 between-group (SZ/CN; group) by 5 within-subjects (acceptance, joy, anger, sadness, neutral; rating) by 2 within-subjects (joy, sadness; target) by 2 within-subjects (AO, AV incongruent; condition) repeated measures mixed model ANOVA was conducted for percent ratings of emotional categories to assess whether there were significant differences between groups in the distribution of emotional judgments across emotion response options and emotional condition. Because Mauchley's test indicated violation of sphericity, with epsilon $< .7$, a Greenhouse-Geisser correction was applied. The group by rating by target by condition interaction was significant ($F(2.70, 140.52) = 8.39$, $p < .001$), indicating that the schizophrenia and control groups made different emotional judgments across the emotion response options and target condition.

As can be seen from Figures 5 and 6, healthy controls rated the AV incongruent stimuli most often as their intended emotion category or neutral. For joyous AV incongruent stimuli, controls also frequently rated such presentations as acceptance. The largest differences among the groups occurred for sadness and joy ratings across conditions, and for judgments of anger in AV incongruent productions of auditory joy. SZ participants rated the emotion as the emotional target less often than controls (joy: $F(1, 52) = 5.47$, $p = .02$; sadness: ($F(1, 52) = 29.94$, $p < .001$), while also rating the AV incongruent stimuli as the visually presented emotion more often than controls across sad and joyous AV incongruent stimuli (joy: $F(1, 52) = 11.44$, $p = .001$; sadness: ($F(1, 52) = 17.13$, $p < .001$).

Based on the significant interaction effect and apparent differences between groups and across emotions as seen in Figures 5 and 6, further analyses were conducted for the CN and SZ groups individually to compare the percent ratings of emotions as a function of condition. ANOVAs were used to compare the distribution of percent emotional judgments for each condition (AO, AV incongruent). For both the SZ and CN groups, there was a significant main effect for condition ($F(1, 39) = 97.50$; $p < .001$ and $F(1, 13) = 46.47$; $p < .001$, respectively). Given the observation of these main effects, the hypothesis that there would be a shift out of intended emotional category when incongruent stimuli were presented could be investigated.

For both the CN and SZ groups, paired samples *t* tests were conducted to compare percent emotional judgments to the intended emotion between AO and AV incongruent conditions for each intended emotion (i.e., joy judgments in AO vs AV incongruent for auditory joy, and sad judgments in AO vs AV incongruent for auditory sadness). Paired samples *t* tests demonstrated that the SZ group rated both joyful ($t(39) = 4.94$; $p < .001$) and sad ($t(39) = 5.10$; $p < .001$) auditory productions less frequently as such in AV incongruent conditions when compared to AO conditions. CN did not demonstrate a significant change in the frequency of ratings of joyous ($t(13) = 0.43$; $p = .68$) or sad ($t(13) = 1.25$; $p = .23$) auditory productions between AO and AV incongruent conditions. Thus, for CN, a perceptual shift out of emotional category was not supported for sad or joyous auditory presentations, while SZ demonstrated a significant shift for both sad and joyous auditory productions.

To examine emotional rating differences for each individual emotion between AO and AV incongruent conditions (i.e., the direction of the shift), paired samples *t* tests were conducted for each emotion (acceptance, joy, anger, sadness, and neutral) within each category that demonstrated a significant shift between AO and AV incongruent conditions. We made these comparisons only for SZ participants, since CN did not show a significant shift for either emotional category. Paired samples *t* tests are reported above for the auditorily presented emotion and are not repeated here. SZ judged auditory productions of joy significantly more frequently as acceptance, anger, and sadness in AV incongruent than in AO conditions (acceptance: $t(39) = 2.84$; $p < .01$, anger: $t(39) = 2.18$; $p < .05$, sadness: $t(39) = 3.93$; $p < .001$). SZ judged auditory productions of sadness significantly more frequently as acceptance and joy, and significantly less frequently as anger and neutral in AV incongruent conditions compared to AO conditions (acceptance: $t(39) = 3.28$; $p < .01$, joy: $t(39) = 7.32$; $p < .001$, anger: $t(39) = -2.63$; $p < .05$, neutral: $t(39) = -5.92$; $p < .001$).

To elucidate these findings, difference scores for percent judgments of each emotion between AO and AV incongruent conditions for auditory joy and sadness are presented in Figures 7 and 8, respectively**.** Bars below zero indicate emotions judged more often in the AO condition, whereas bars above the zero line show emotions rated more often in AV incongruent conditions than AO conditions. Examination of these data indicates that persons with schizophrenia shift most often into the visually presented modality when presented with bimodal incongruent stimuli of either auditory valence. Healthy control participants demonstrated a similar pattern of ratings; however, the emotional shift was not significant.

Chapter 4

Discussion

The purpose of this study was twofold: to examine differences in emotional judgment between healthy controls and persons with schizophrenia, and to demonstrate a perceptual shift in emotional judgment. Though we did not observe a significant shift out of emotional categories when bimodal incongruent stimuli were presented, we made novel observations that serve to elucidate putative mechanisms behind well-validated emotion recognition deficits in schizophrenia. Persons with schizophrenia had reduced accuracy compared to healthy controls when making emotional judgments; given the robust literature demonstrating poorer emotional judgment in persons with schizophrenia (Javitt et al., 2000; Johnson et al., 2001; Kohler et al., 2010; Lee et al., 2010; Shin et al., 2008; Simosky et al., 2003; Weintraub et al., 2012), such a finding is not surprising.

Interestingly, individual analyses for frequency of response to emotional categories in the bimodal incongruent conditions reveal significant between-group differences for both joy and sadness. Figure 3 revealed that persons with schizophrenia, when asked to rate the auditory emotion, rated auditory sadness less accurately than healthy controls when auditory sadness was paired with visual joy. Persons with schizophrenia also rated auditory sadness as the visually presented emotion of joy significantly more frequently than did controls (see Figure 8). This same pattern of observations was made for auditory joy when presented with visual sadness (see Figures 3 and 7). The schizophrenia group rated auditory joy as such less frequently than controls and rated stimuli as the visually presented emotion of sadness more frequently than other emotional categories. This pattern indicates that when presented with conflicting information across auditory and visual channels, persons with schizophrenia rely more heavily on the visual signal. This was expected given well-established deficits in the processing of auditory emotional information resulting from more basic auditory processing deficits (Gold et al., 2012; Leitman et al., 2010) and evidence for visual preference when making emotional judgments (Sestito et al., 2013). Consistent with previous research (de Gelder et al., 2013), this preference is most pronounced when asked to judge auditory sadness. Though our schizophrenia group shifted to use of the visual channel most often in both cases, the reliance on the visually presented emotion of joy for bimodal incongruent presentations of auditory sadness is stark. These findings suggest that observed deficits in the perception of complex human emotional expressions such as sarcasm and irony (Chung et al., 2011; Horan et al., 2011; Lee et al., 2004; Ringdahl, in preparation) might be caused or compounded by over-reliance on the visual channel. These judgments are highly important for social interaction and often require integration of auditory and visual social information (e.g., a facial expression that does not match a vocal expression in an ironic statement).

Another interesting finding is the observation that when confronted with a happy voice and a sad face, persons with schizophrenia misjudge these productions more frequently than controls. Research has demonstrated that for persons with schizophrenia, emotion perception deficits seem to be most pronounced for negative emotions (de Gelder et al., 2013), and we have observed that persons with schizophrenia seem to preferentially use visual information when making emotional judgments of phonemic information. Perhaps when presented with auditory joyous information, an emotion judgment condition less impaired than negative emotional judgments, perceptual interactions between sensory modalities observed in healthy controls (Collignon et al., 2008; de Gelder & Vroomen, 2000; Massaro, 1998; Massaro & Egan, 1996) may occur, leading to this shift out of category. The results of this study, however, cannot rule out the possibility that the difference between healthy controls and persons with schizophrenia for this condition were not the result of responses when the visual signal did not take precedence.

As discussed above, persons with schizophrenia seemed to rely on the visual signal on trials for which such information was available. Though at first blush this near neglect of important auditory cues may be interpreted as a deficient approach, it may indeed represent an optimal strategy for this population. When locating stimuli across auditory and visual domains, people rely on the stimulus that provides the greatest information value. Alias and Burr's (2004) research on this phenomenon points out that this strategy represents the optimal use of sensory information. Auditory emotion-perception deficits (Gold et al., 2012), as well as deficits in the perception of basic aspects of pitch, amplitude, and frequency (Ramage et al., 2012; Snyder & Alain, 2007; Weintraub et al., 2012) have been established in persons with schizophrenia. Hence, the observation that this group relies on the visual signal when presented with conflicting information may indeed represent an area of adaptation rather than deficit. Perhaps, when this visual information conflicts with sensory information of lesser discriminative value to this group, visual information takes precedence as it may convey the greatest information value. Future research could explore this hypothesis by specifically manipulating the quality of paired audio/visual exemplars of emotional stimuli and analyzing the frequency of judgment according to stimulus quality, rather than emotional valence.

A great debate has been fought for decades in the schizophrenia research, stemming from the work of Chapman and Chapman (1973; 1978) with regard to task difficulty. Often, research focuses on the use of task parameters that are challenging, with the idea that between healthy control participants and those with schizophrenia the same processes are being tapped. Persons with schizophrenia have generalized deficits, such that it is difficult to assume that the same process is being tapped when this population completes a task on which performance is poorer than for controls. One solution posited to disambiguate this is to create a condition in which both groups demonstrate similar performance, and observe changes as task demands are increased, without selecting for unimpaired persons with schizophrenia; admittedly this is a difficult bar to meet. Our data for joyous stimuli are unique in that they present a task on which healthy control participants and persons with schizophrenia performed similarly until the task demands were increased (compare unimodal data presented in Figure 2 on which groups performed similarly with those of Figures 3 and 7), perhaps providing preliminary evidence for a paradigm that satisfies the ideal proposed by Chapman and Chapman's work. Making such a claim, however, is highly tentative on the basis of one task within a study, and it is possible that the difficulty of this condition caused a floor effect for both groups, thus making them appear to perform similarly. This finding nonetheless provides a unique observation that warrants further investigation.

Consistent with previous research, these results provide evidence for a deficit in auditory emotional judgment in persons with schizophrenia. This deficit is present in stimuli that are very similar to what would be observed during social interactions, and not conflated by non task-relevant linguistic cues. The findings of this study serve to extend well-validated experimental paradigms by providing generalizable results that explain real-world outcome such as social functioning and understanding of complex emotional interactions such as sarcasm, irony, or deceit. Overall, these results indicate that in situations where it is difficult to judge emotional expressions, individuals with schizophrenia have particular difficulty with both joy and sadness, especially when auditory cues are necessary for making such judgments.

Limitations

The hypothesis that the control group would reliably shift into an emotional condition that did not represent one of the two original emotional expressions for incongruent stimuli was not supported. Participants frequently judged incongruent stimuli as neutral. It is likely that participants were frequently unsure what to make of incongruent stimuli and rated them as neutral. It is also possible that participants were able to recognize that each component of the stimulus represented one component of a dichotomy and thought that the ‘right’ choice was neutral. In either case, the number of responses to the neutral condition prevented this study from examining a perceptual shift without removing meaningful data. Future studies of a perceptual shift from theoretically opposing emotional stimuli may benefit from excluding a neutral response option.

Much work was done to alter the stimuli, and for purposes that aimed to improve the internal validity of the paradigm. The acoustic alterations may have reduced generalizability. Though our acoustic features were highly consistent across stimuli, anecdotally the resulting auditory stimuli were recognizable as somehow different from natural. This observable deviation from human timbre could have also made the task more difficult, thus contributing to our observed low accuracy rate for judgment of auditory joy (and therefore AV incongruent expressions of auditory joy, as these included the same auditory expressions). In prior studies of healthy controls using these stimuli, similar low accuracy was observed for this same condition (Forrest, 2002). To understand why these differences were observed, a study comparing the altered stimuli to their original vocal productions may shed light on whether the alteration of the auditory stimuli or the vocal productions of joy themselves were hard to recognize.

Because persons with schizophrenia made a significant ‘shift’ out of emotional category as indexed by significant differences in the frequency of correct ratings of AO vs AV incongruent expressions of the same emotion, an argument could be made that persons with schizophrenia simply failed to understand the task parameters when it became more complex. That is to say, perhaps SZ failed to make judgments of the auditory emotion as they were asked to. Were this the case, however, one would expect that the frequency of judgments in the AV incongruent condition would be similar for the auditory and visual condition. We see, especially for judgments of auditory sadness in AV incongruent conditions (an emotional category inaccurately judged by persons with schizophrenia), a substantial preference for the use of the visually presented emotion. Thus, the more parsimonious explanation is that this shift reflects a true difference between SZ and CN other than failure to comply with task parameters. Additionally, as a check to assure compliance with task parameters, participants were removed who did not perform adequately on a simpler phoneme identification task.

This task required people to judge several different productions of auditory and visual joy or sadness, which differed minimally within condition, such that both ‘good’ and ‘less good’ exemplars of each emotional expression were presented to all participants. Participants were then asked to select from a series of five emotional response options, three of which did not have corresponding stimuli. It is possible that this created a response criterion such that participants felt as though these conditions must be present in the task, and therefore selected these items for stimuli that would otherwise have been labeled as the intended emotion condition irrespective of the perception of these stimuli as other than their component emotion parts. Better cognitive functioning is likely to moderate this hypothesized interaction, and as such it is expected that this would be most pronounced for healthy controls. Concurrent with this hypothesis there was a non-significant quantitative difference in judgment of auditory joy such that persons with schizophrenia performed better on this condition. This pattern would be expected for a condition judged inaccurately overall, as lower accuracy scores necessarily mean that judgments were made according to a response option to which the stimulus did not belong. Future studies may address this concern by including ‘dummy’ productions that clearly match the other emotional response conditions to alleviate this response criterion.

Appendix A: Table

Table 1

Demographic and symptom data

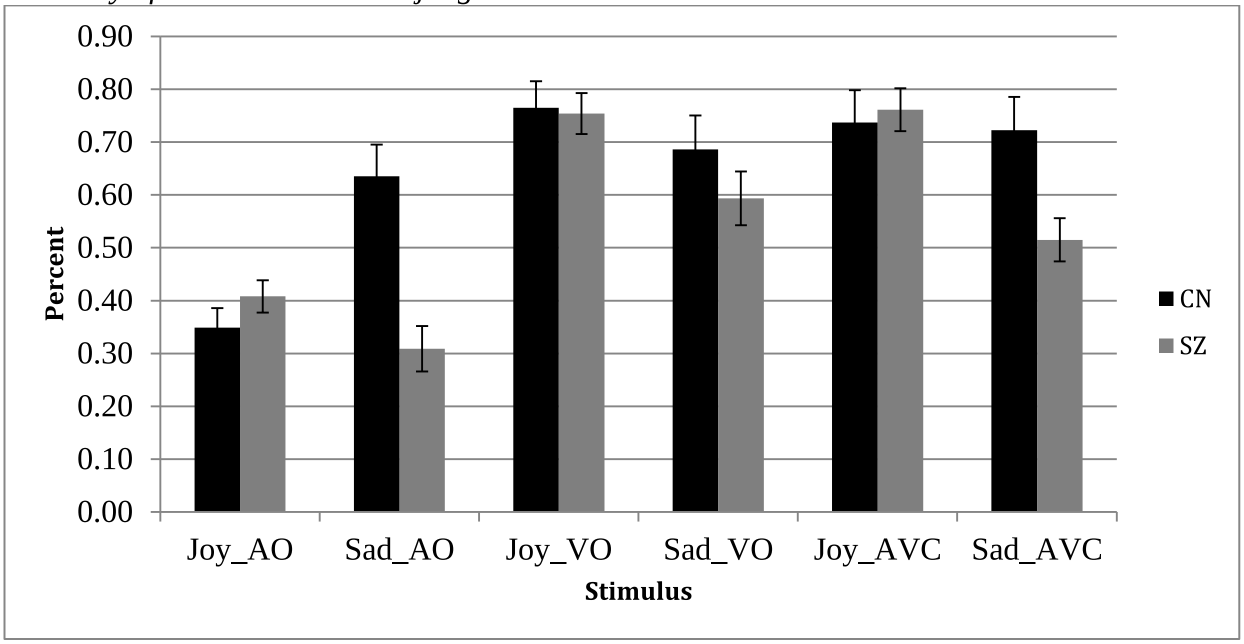
Variable	Group		Statistical Comparison
	CN	SZ	
Sex (*n*)			$\chi^2(1) = 4.10$ ($p = .043$)
Male	10	16	
Female	4	24	
Ethnicity (*n*)			$\chi^2(5) = 15.30$ ($p < .01$)
African American	0	17	
Asian	1	2	
Biracial	2	0	
Caucasian	9	19	
Hispanic/Latino	1	2	
Other	1	0	
	Mean (SD)	Mean (SD)	
Estimated FSIQ	98.77 (11.85)	80.08 (11.49)	$F(1, 52) = 25.58$ ($p < .001$)
Age	35.79 (10.39)	43.63 (11.72)	$F(1, 53) = 4.89$ ($p = .031$)
Education	13.61 (1.84)	12.29 (1.92)	$F(1, 53) = 4.98$ ($p = .030$)
Hollingshead Index	40.42 (14.66)	24.74 (9.90)	$F(1, 49) = 18.142$ ($p < .001$)
CPZ Equivalent Dosage	0.0 (0.0)	687.84 (708.17)	--
BPRS Total Score	--	39.25 (8.94)	--
SANS Total Score	--	42.00 (27.33)	--
SAPS Total Score	--	28.50 (17.71)	--

Note. CN = Control group; SZ = Schizophrenia group.

Appendix B: Figures

Figure 1

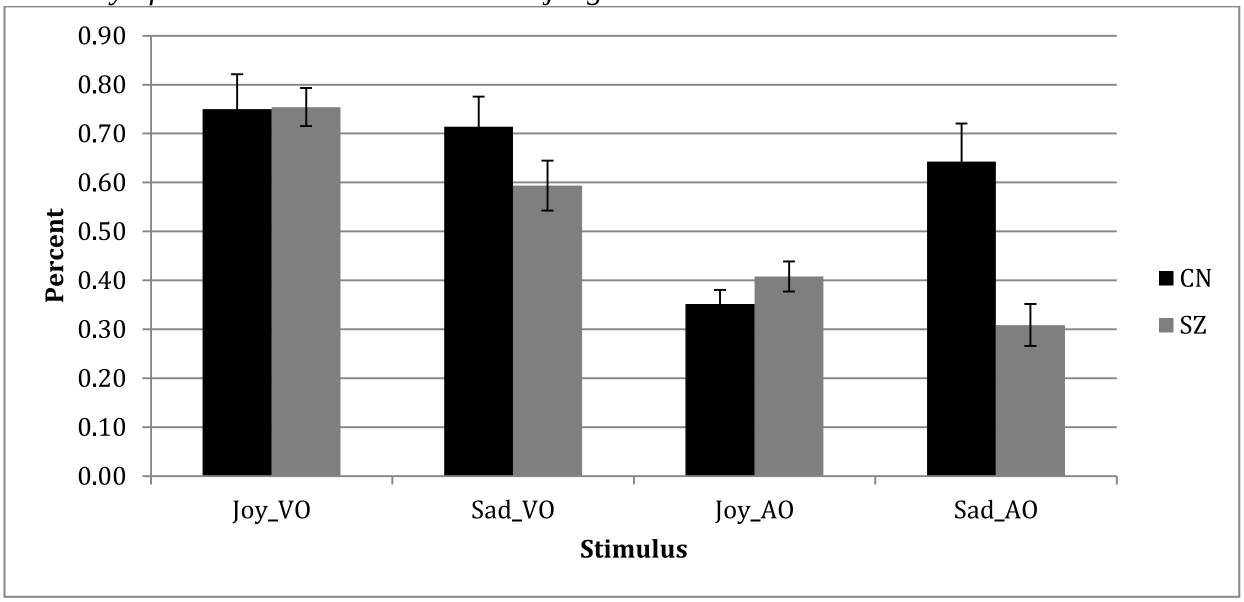
Accuracy of emotional stimulus judgments



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group. AO = Auditory Only; VO = Visual Only; AVC = Audiovisual Congruent.

Figure 2

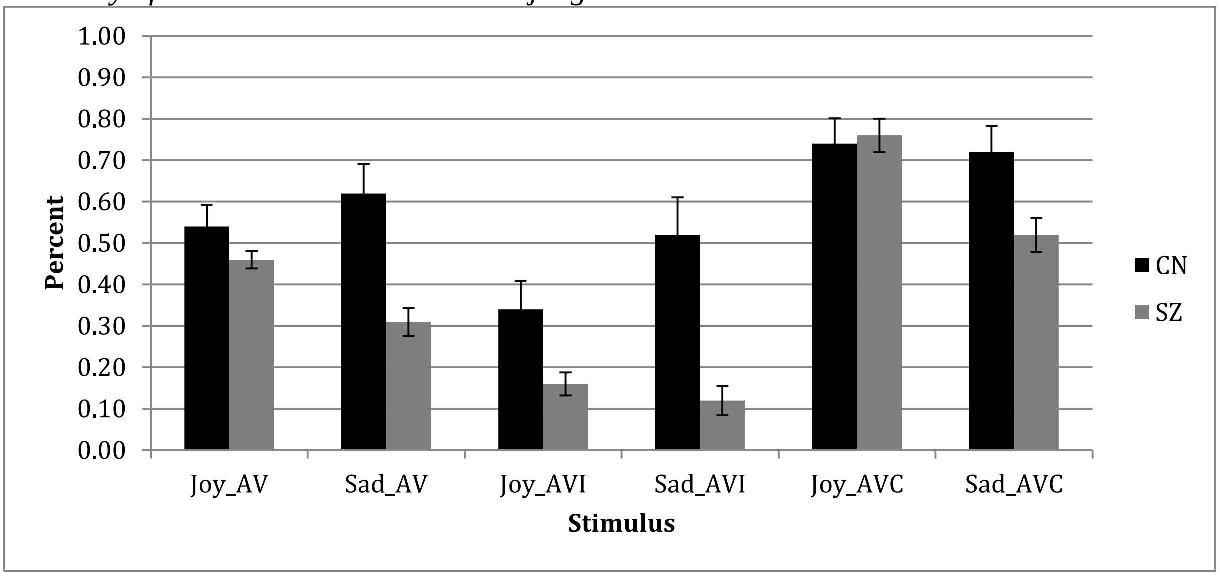
Accuracy of unimodal emotional stimulus judgments



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group. AO = Auditory Only; VO = Visual Only.

Figure 3

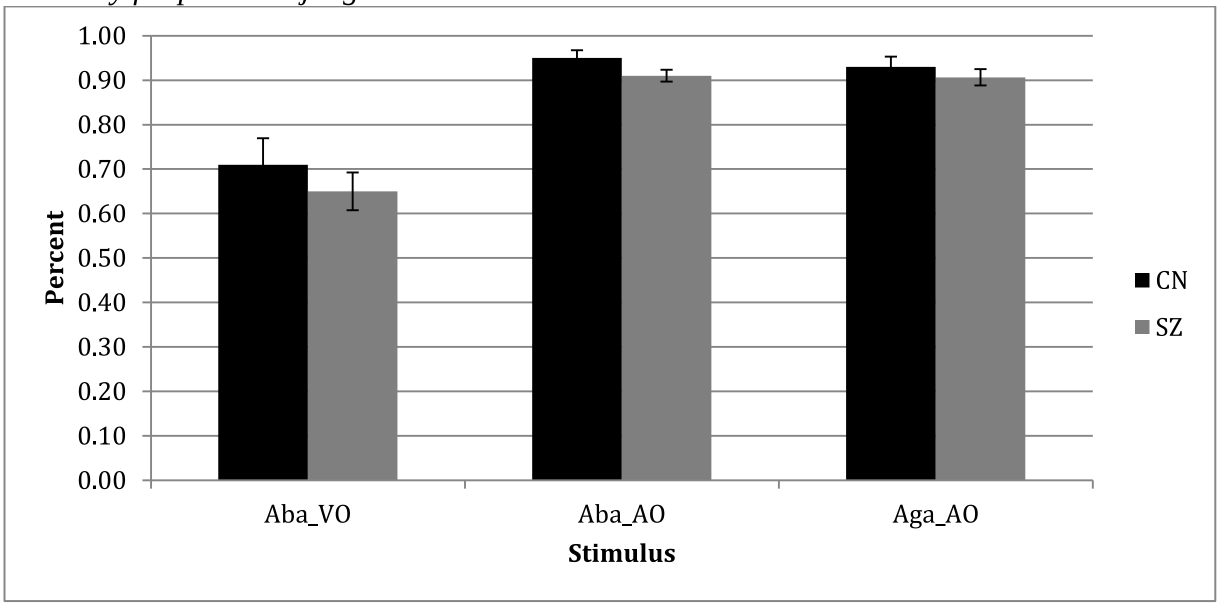
Accuracy of bimodal emotional stimulus judgments



Note. Error bars represent 1 SE. AV = combined AVI/AVC. AVI = Audiovisual Incongruent; AVC = Audiovisual Congruent. CN = Control group; SZ = Schizophrenia group.

Figure 4

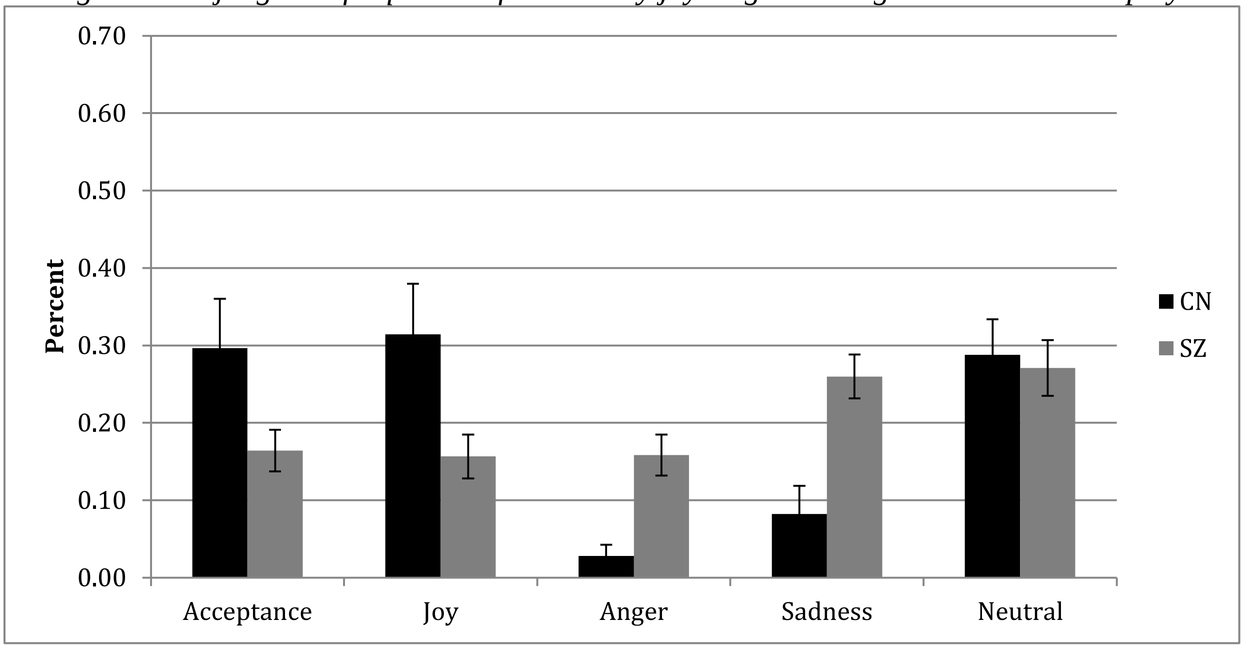
Accuracy for phoneme judgments



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group. VO = Visual Only; AO = Auditory Only.

Figure 5

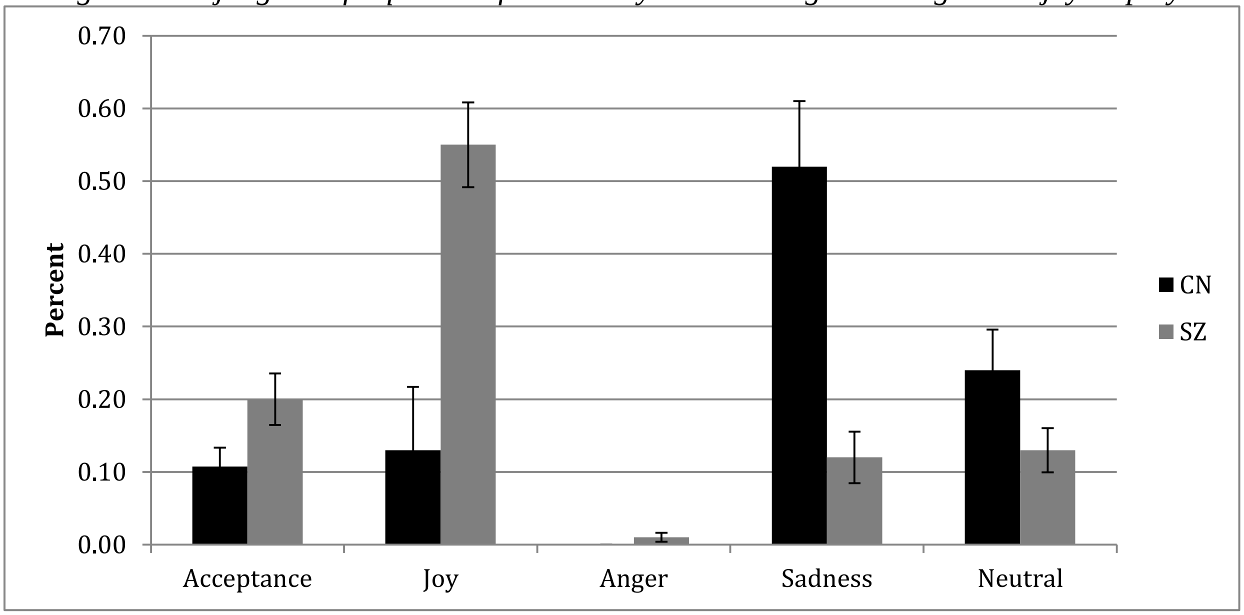
Incongruent AV judgment frequencies for auditory joy targets during visual sadness displays



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group.

Figure 6

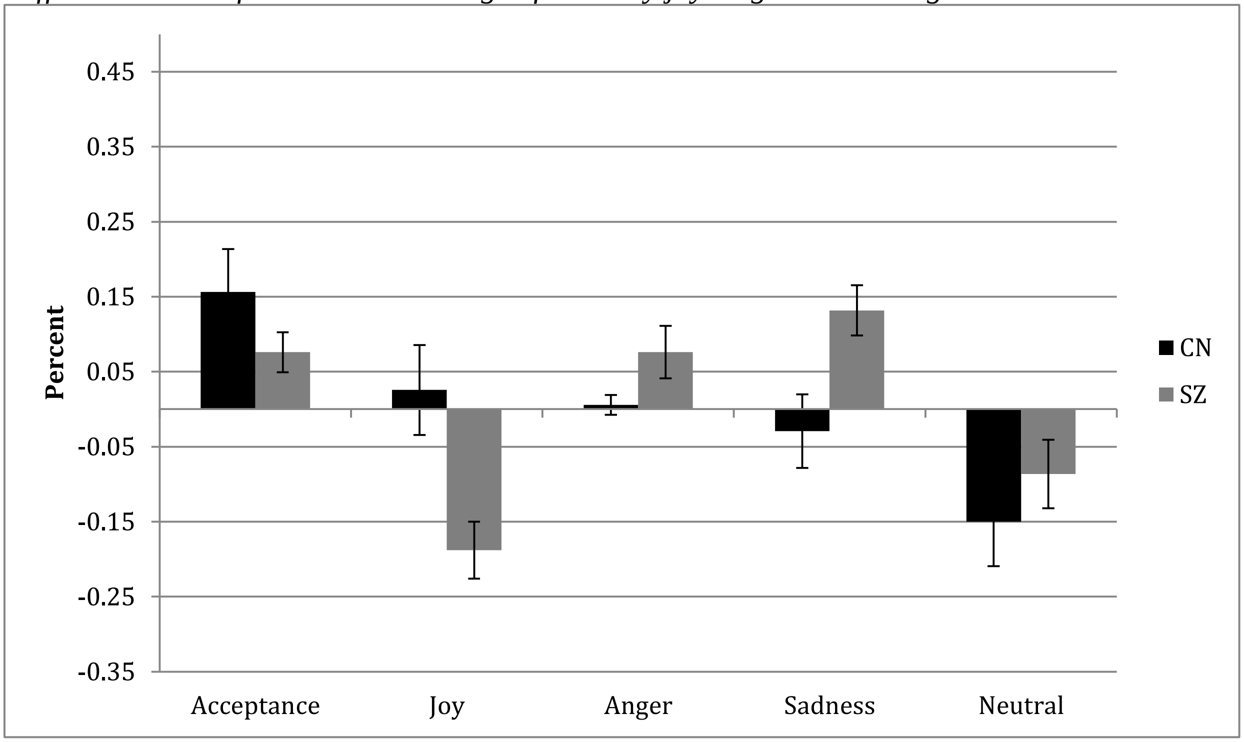
Incongruent AV judgment frequencies for auditory sadness targets during visual joy displays



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group.

Figure 7

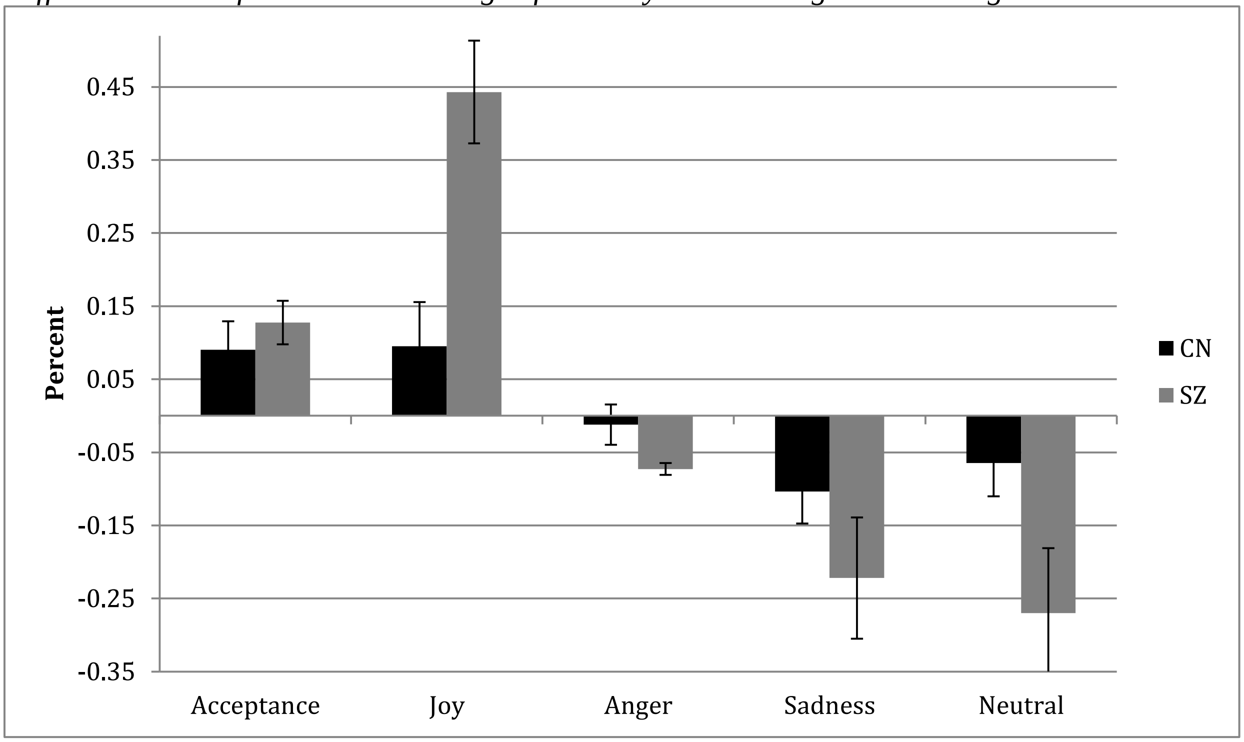
Difference scores for emotional ratings of auditory joy target: AV incongruent – AO



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group.

Figure 8

Difference scores for emotional ratings of auditory sadness target: AV incongruent – AO



Note. Error bars represent 1 SE. CN = Control group; SZ = Schizophrenia group.

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Curriculum Vitae

BERN G. LEE

<u>Contact</u>

4505 S Maryland Pkwy

Mailstop 455030 (541)510-8494

Las Vegas, NV, 89154 bernglee@gmail.com

<u>EDUCATION</u>

University of Nevada, Las Vegas Fall 2012–Present

Las Vegas, NV Advisor: Daniel N. Allen, Ph.D.

Doctoral Student in APA-Accredited Clinical Psychology Program

Master of Arts in Clinical Psychology Candidate for 2015 Graduation

Thesis: Integration of Audio-visual emotional information in Schizophrenia.

Hood College Fall 2007 – 2012

Frederick, MD Advisor: Shannon Kundey, Ph.D.

Bachelor of Arts Major: Psychology Conferred January 2012

Honors Thesis: Language Learning and Retention: A Comparative Assessment of the Effects of Cognitive Effort and Context Learning Theories.

BRIEF RESEARCH INTERESTS

Cognitive and affective symptoms of severe mental illness are serious and debilitating, and are thought to have complex neural underpinnings. My research aims to better understand how cognition relates to the emotional experience through use of neuropsychological testing, psychophysiological investigation of emotional arousal, and eye-tracking methodology. It is the hope that through the integration of these often-separate techniques, we may shed light on processes that have thus far proved elusive. Long-term, it is my intention to continue to apply contemporary methods of investigation to explore these neural mechanisms, and translate basic findings into novel treatments for specific domains of psychopathology.

RESEARCH EXPERIENCE

Graduate Research

Neuropsychology Research Program Summer 2012–Present

University of Nevada, Las Vegas Advisor: Daniel N. Allen, Ph.D.

Emotion Regulation Studies:

In continuation of a line of research begun at the Maryland Psychiatric Research Center within the University of Maryland School of Medicine, I have translated paradigms designed for event-related Potential EEG methodology into combined eye-tracking and psychophysiological data collection. Duties included writing IRB proposals, writing grants for funding of research, setting up hardware for and troubleshooting ASL eye-tracking equipment, and directly supervising and training a team of research assistants in eye tracking and psychophysiological data collection methods, e prime, informed consent, and neuropsychological test administration.

Wechsler Intelligence Scale for Children, 5th Ed. (WISC-V) Validation Study:

The WISC series of tests are preeminent measures of executive and intellectual functioning. Through cooperation with Pearson®, I have assisted in the validation of this important psychological measure on both healthy children and those who had suffered a traumatic brain injury. Duties included administering the testing battery, gathering information about the family, and working with those at Pearson® to transfer and review test data.

Validation of the Halstead Category Test Computer Version, and Search Identification Task:

I trained undergraduate research assistants on administration, scoring, and data entry procedures. The project involves a two-part assessment, each lasting 2-hours and occurring within 7-14 days of one another, and requires research assistants to be proficient in administration of neuropsychological test battery and computerized measures.

The Optimum Performance Program in Sports Fall 2012–Spring 2014

University of Nevada, Las Vegas Advisors: Bradley Donohue, Ph.D.

Daniel N. Allen, Ph.D.

Family Behavioral Therapy:

Through working on an R01 grant, I developed and refined experimental protocols and conducted assessments with NCAA athletes for examination of psychological symptoms and substance use. Some assessment measures included: Structured Clinical Interview for the DSM-IV, Beck Depression Inventory, Risk Assessment Battery, Symptom Checklist 90 Revised, and Timeline Follow-back interview focusing on alcohol use, drug use, and sexual behavior.

Pre-Graduate Research

University of Maryland School of Medicine; Maryland Psychiatric Research Center.

Summer 2011 January-May 2012

Advisor: Gregory P Strauss, Ph.D.

Schizophrenia Research

During my work at the MPRC, I created, statistically analyzed, and subsequently normalized sets of stimuli for a variety of ERP, eye-tracking, and behavioral computer tasks. I taught myself to use Eye-Link, Experiment Builder, and E-Prime, and programmed tasks on these platforms for use with EEG, eye-tracking, and behavioral tasks. I also participated in live clinical diagnostic interviews, as well as one-on-one patient interaction. I was given the opportunity to engage in the writing and study design process for authorship on publications. I also resolved computer-program interface issues for use of video and audio in E-Prime, and gained experience with eye-tracker and EEG, and used eye-tracker to run participants.

Independent Undergraduate Honors Thesis Research Project: Hood College

Fall 2012

Advisor: Shannon M. Kundey, Ph.D.

Invitational Tischer Scholarship Departmental Honors Thesis:

I conducted independent research on learning and retention from the ground up. I completed a comprehensive a literature review, designed an experiment, created stimulus sets and measures, recruited participants, conducted research, analyzed data, and completed an honors thesis, within one semester.

Research Assistant: Hood College Comparative Cognition Laboratory

2009-2011

Advisor: Shannon M. Kundey, Ph.D.

I began work in this lab after my sophomore year, and continued work with the lab consistently throughout my undergraduate career and for a brief time afterward. Eventually taking a leadership role, I trained research assistants in the operationalization of cognitive research and the paradigms used by the lab, ran participants through a wide variety of SuperLab based serial learning tasks, coded data, statistically analyzed data using SPSS, and scheduled participants for experiments.

PUBLICATIONS AND PRESENTATIONS

Research Publications in Peer Reviewed Journals

Whearty, K. M., Allen, D. N., **Lee, B. G**., & Strauss, G. P. (In Press). The evaluation of insufficient cognitive effort in schizophrenia in light of low IQ scores. *Journal of Psychiatric Research.*

Strauss, G. P., Thaler, N. S., Mateeva, T. M., Vogel, S. J., Sutton, G. P., **Lee, B. G.**, & Allen, D. N. (2015). Predicting psychosis across diagnostic boundaries: Behavioral and computational modeling evidence for impaired reinforcement learning in schizophrenia and bipolar disorder with a history of psychosis. *Journal of Abnormal Psychology*

Strauss, G. P., Kappenman, E. S., Culbreth, A. J., Catalano, L. T., **Lee, B. G**., & Gold, J. M. (2013). Emotion Regulation Abnormalities in Schizophrenia: Cognitive Change Strategies Fail to Decrease the Neural Response to Unpleasant Stimuli. *Schizophrenia Bulletin*.

Kundey, S. M. A., De Los Reyes, A., Rowan, J. D., **Lee, B**., Delise, J., Molina, S., & German, R. (2013)

Involvement of Working Memory in College Students' Sequential Pattern Learning and Performance. *Learning and Motivation.*

Strauss, G. P., **Lee, B. G**., Waltz, J. A., Robinson, B. M., Brown, J. K., Gold, J. M. (2012). Cognition-

Emotion Interactions are Modulated by Working Memory Capacity in Individuals with Schizophrenia. *Schizophrenia Research*.

De Los Reyes, A., Alado, A., Kundey, S. M. A., **Lee, B. G**., &Molina, S. (2012). Compromised decision-making and the effects of manipulating physical states on human judgments. *Journal of Clinical Psychology* 68(1), 1-7.

Book Chapters

Allen DN, **Lee BG**, Thaler NS (2013). Mental illness and substance abuse. In DN Allen & SP Woods (Eds), *Evidence based neuropsychological approaches to substance use disorders*. Oxford University Press: New York.

Zink, DP, **Lee, BG**, Allen, DN (2014). Structured and Semi-Structured Clinical Interviews Available for use Among African American Clients: Cultural Considerations in the Diagnostic Interview Process. In L. Buento & B. D. Leany (Eds.), *Guide to Psychological Assessment with African-Americans.* Springer Publishing: New York.

Posters and Presentations

* Denotes presentation with corresponding published abstract

***Lee, B.**, Copeland, V., & Allen, D. (2015). Meta-analytic investigation of neuropsychological performance in persons with schizophrenia and co-occurring substance use disorders. Poster to be presented at the National Academy of Neuropsychology Conference, Austin, TX., USA.

Loughran, T., **Lee, B.**, Zink, D., & Barchard, K. (2015). A psychometric evaluation of the emotion-based decision making scale. Poster presented at the Nevada Psychological Association annual conference, Las Vegas, NV, USA.

Dadis, F., Vogel, S. J., **Lee, B. G**., Mayfield, J., & Allen, D. N. (2014). The Delis-Kaplan Trail Making Test (D-KEFS) is sensitive to injury and recovery in children with brain injury. presented at the Western Psychological Association Conference, Portland, OR, USA.

*__Lee, B__., Mayfield, J., Thaler, N., Farcello, C., and Allen, D. (2013). Differential Predictors of Simple and Complex Sequencing in the Comprehensive Trail Making Test. Poster presented at the National Academy of Neuropsychology Conference, San Diego, CA, USA.

*__Lee, B.G__., Strauss, G.P., Adams, J.L., Martins, D.O., Catalano, L.T., Waltz, J.A., Gold, J.M. (2012). Defeatist Performance Beliefs Predict Neuropsychological Impairment, Functional Outcome, and Negative Symptoms in Schizophrenia. Poster presented at the National Academy of Neuropsychology Conference, Nashville, TN, USA.

Lee, B.G., Barney, S.J., Catalano, L.T., Ringdahl, E.N., Vertinski, M., Adams, J.L., Shugarman, Y.Y., Snyder, J.S., Allen, D.N., Strauss, G.P. (2012). Anhedonia is Associated with Impaired Long-Term Memory for Positive Emotional Stimuli in Individuals with Schizophrenia. Poster presented at the Society for Research in Psychopathology, Ann Arbor, MI, USA.

Catalano, L.T., Keller, W.R., **Lee, B.G**., Martins, D.O., Adams, J.L, Shugarman, Y.Y., Llerena, K., Gold, J.M., Buchanan, R.W., Strauss, G.P. (2012). The nature of emotional experience abnormalities in schizophrenia: Is it affective ambivalence or negative emotionality? Poster presented at the Society for Research in Psychopathology, Ann Arbor, MI, USA.

De Los Reyes, A., Alado, A., Kundey, S.M.A., **Lee, B.G**., &Molina, S. (2012). Compromised decision-making and the effects of manipulating physical states on human judgments. Association for Psychological Science, Washington, D.C., USA

De Los Reyes, A., Aldao, A., Kundey, S.M.A., **Lee, Bern G**., Molina S., (2011) Compromised decisionmaking and the effects of manipulating physical states on human judgments. Poster to be presented at the Association for Behavioral and Cognitive Therapies, Toronto, Ontario.

Molina, S., Kundey, S.M.A., De Los Reyes, A., Coshun, A., German, R., Monnier, B., & **Lee, B**. (2011). Irrelevant Relations Impair Human Serial Pattern Learning Performance. Poster presented at the Undergraduate Research Celebration Poster Session at Hood College, Frederick, MD, USA.

Vilson, F.J., Strauss, G.P., **Lee, B.G**., Gold, J.M. (2011, July). Towards a Mechanistic Understanding of Avolition and Anhedonia in Schizophrenia: The Role of Dopamine Dependent Reinforcement Learning Deficits. Poster presented at the Ronald E. McNair Scholars program Conference, College Station, PA, USA.

CLINICAL TRAINING

The Cleveland Clinic Lou Ruvo Center for Brain Health July 2015 - Present

Supervisor:

Justin Miller, Ph.D.

- **Doctoral Practicum Student:** Administered a standardized neuropsychological battery tailored for the assessment of adults referred for dementia. Wrote 1-2 neuropsychological reports per week under the supervision of Dr. Miller.
- **Supervision and Didactics:** Didactics included weekly grand rounds discussion of complex patients with a diverse team of treatment providers, inclusive of neurologists,

psychologists, physical therapists, and social workers. Supervision was conducted on an individual basis and included direct training in effective report writing and case conceptualization.

The Center for Applied Neuroscience July 2014 - August 2015

Supervisors:

Thomas Kinsora, Ph.D.

Sharon Jones-Forrester, Ph.D.

- **Doctoral Practicum Student:** Conducted neuropsychological assessment on a broad range of patients across the age span within the civilian and military populations. Patient groups included persons with suspected dementia, history of traumatic brain injury or concussion, neurodevelopmental or acquired neurocognitive disorders, and persons with severe mental illness or learning disabilities. Wrote approximately one clinical neuropsychological report per week for these patients.
- **Supervision and Didactics:** Didactic training included specific education about neuropsychological correlates of TBI, PTSD, Dementia, and other disorders of neurocognition. Supervision consisted of group and individual meetings during which report writing and patient care were reviewed. Specific patients were discussed in terms of differential diagnosis and accommodations related to their neuropsychological status.

The UNLV Partnership for Research, Assessment, Counseling, Therapy and Innovative Clinical Education (PRACTICE)

August 2013–August 2014

Supervisor: Stephen Benning, Ph.D.

- **Doctoral Practicum Student:** Provided long-term individual therapy to a caseload of approximately 4-6 clients per week in an outpatient University affiliated mental health clinic. Diagnoses included personality disorders, affective disorders with and without psychotic features, and anxiety disorders. Primary theoretical approach used were CBT and Interpersonal Psychotherapy under the supervision of Stephen Benning, PhD
- **Supervision and Didactics:** Supervision consisted of weekly individual and group meetings with videotape review as well as weekly practicum seminars, which included didactic, group supervision, and case conference components. Didactic training focused on therapy from an ACT perspective inclusive of lecture, student presentation on therapeutically related topics, and case conceptualization.

Psychological Assessment & Testing Clinic (PATC) August 2013–Present

Supervisor: Michelle G. Paul, Ph.D.

- **PATC Assessment Coordinator:** Conducted intake and screening interviews for all clients tested through the PATC clinic (approx. 10-20 per week), coordinated case assignments in accordance with skill-set, training need of assessors, and client need. Duties also included client tracking for all active assessments and waitlist, reviewing clinical records and conducting audits for adherence to protocol and appropriate electronic notation, and creating and mailing intake paperwork for clients.

- **Doctoral Practicum Student:** Conducted neuropsychological, psycho-educational, and psychodiagnostic assessments using a flexible battery approach with adults referred from the community in an outpatient University affiliated mental health clinic. Further responsibilities included interviewing, scoring, interpretation, report writing, and provision of feedback to clients.
- **Supervision:** Supervision included reviewing cases, joint determination of assessment battery and interpretation of results, report revisions, and discussion of feedback.

PROFESSIONAL AFFILIATIONS

National Academy of Neuropsychology, Student Affiliate 2012–Present

American Psychological Association, Student Affiliate 2013–Present

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OTHER RELEVANT WORK AND TRAINING EXPERIENCE

Health Insurance Privacy and Portability Act (HIPPA) Certification Fall 2013-Present

SCID Training Program Fall 2012

Training Supervisor: Daniel N. Allen, Ph.D.

Completed a training program over three months and made up of approximately 40 hours for administration of the Structured Clinical Interview of the DSM-IV-TR Axis I Disorders (SCID).

The Collaborative IRB Training Initiative (CITI) Program Fall 2011-Present

(http://www.citiprogram.org).

TEACHING EXPERIENCE

University of Nevada, Las Vegas Fall 2014-Present

- Designed and taught two sections of Psychology 101 per semester. Duties included lecture, designing assignments and tests, grading students, and holding office hours.

Eagle Rock School and Professional Development Center 2006

- Co-designed and co-instructed a high school level course with an instructor at the school, addressing the social impacts of visual media and the expression of contemporary hot-button topics by comedic programs.

AWARDS AND HONORS

UNV Graduate and Professional Student Association Travel Grant $645 2014

UNLV Graduate and Professional Student Association Research Grant $405 2013

UNLV Graduate and Professional Student Association Research Forum 2013

Platform Presentation Award: Honorable Mention

UNLV Graduate and Professional Student Association Research Grant $765 2012

National Academy of Neuropsychology Student Poster Award $100 2012

Hood College Faculty Book Award for Exceptional Achievement in 2012

Psychology

Tischer Scholar: Hood College	2011
Dean’s List: Hood College	2009-2011
Dean’s Scholarship: Hood College $12,000 annually	2008-2011
Trustee Scholarship: Hood College $14,000	2007