EMOTION LABELING WITH VISUAL STIMULI:
THE EFFECTS OF PHYSIOLOGICAL
RESPONSES ON CONDITIONING

by

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ABSTRACT

Emotion labeling occurs when one learns to identify, discriminate, and act upon internal sensations caused by external events. Often, emotion labeling is facilitated by language, in which one learns to recognize the increased heart rate and sudden perspiration caused by the sight of a grizzly bear as “fear”. However, for nonverbal humans, emotion labeling is limited, and emotional competence is delayed. By using visual labels, one can facilitate emotional learning in this population, and, in turn, improve relationships with peers, social skills, and academic performance. The focus of our current study is to investigate whether or not typically developing humans can report their physiological sensations—elicited by stimuli which predict the delivery or absence of money as a reinforcer—using visual stimuli. Results indicated that participants failed to learn the task across experiments, and chose between labels at random. Future research should focus on increasing the salience of external and internal events, when using visual labels to facilitate emotional learning.

Emotion Labeling with Visual Stimuli: The Effects of Physiological Responses on Conditioning

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Abstract

Emotion labeling occurs when one learns to identify, discriminate, and act upon internal sensations caused by external events. Often, emotion labeling is facilitated by language, in which one learns to recognize the increased heart rate and sudden perspiration caused by the sight of a grizzly bear as “fear”. However, for nonverbal humans, emotion labeling is limited, and emotional competence is delayed. By using visual labels, one can facilitate emotional learning in this population, and, in turn, improve relationships with peers, social skills, and academic performance. The focus of our current study is to investigate whether or not typically developing humans can report their physiological sensations—elicited by stimuli which predict the delivery or absence of money as a reinforcer—using visual stimuli. Results indicated that participants failed to learn the task across experiments, and chose between labels at random. Future research should focus on increasing the salience of external and internal events when using visual labels to facilitate emotional learning.

It is common for the public to believe that nonhuman animals experience many of the same emotions as humans—for example, that a dog feels guilty for chewing its owner's shoes. However, this is not a widespread belief among the scientific community. Scientists do not generally attribute emotions to nonhuman animals, as is the case with many covert behaviors. Covert behaviors, such as thoughts or sensations, are not immediately observable, and so are deemed private events. Emotions are considered a uniquely human experience because their expression involves using verbal labels associated with internal, physiological sensations. Without language, it is assumed animals are unable to report their internal state. Humans with language impairments also have trouble labeling their own emotions and those of others, such as individuals with autism spectrum disorders (Denham, 2007). However, the use of verbal labels is not necessary for the experience of emotion. Rather, by using visual labels, one can bring the emotional experience of nonverbal beings closer to that of verbal beings. A visual stimulus, such as a happy face, can be used to label an interoceptive state just as effectively as a verbal label. These are present in many settings, such as the pain scale used in clinical settings. Because quantifying an internal sensation is difficult, especially when one is in pain, the visual labels associated with different levels of pain are immensely helpful; for example, a happy face is associated with no pain, a neutral face with a medium amount of pain, and a distressed face with a high amount of pain. They also help make the experience of pain less subjective, and are better than verbalizing that one is in "a lot" of pain.

The focus of our current study is to investigate whether or not typically developing humans can report their physiological sensations—elicited by stimuli which predict the delivery or absence of money as a reinforcer—using visual stimuli. This task requires discrimination between the internal state caused by reinforcer delivery from an internal state caused by reinforcer omission. Subjects will then select the visual stimulus, a colored shape, corresponding to each experience (reinforcer delivery or omission). These visual stimuli are expected to operate the same way as verbal labels do for human emotions.

Denham (2007) describes an emotional experience as a state of arousal triggered by an environmental event, one's own actions, the actions of others, or memories. This arousal can take one of two routes: lower or higher level emotional experience. More primitive reactions occur when an emotion is ensued automatically, and the response to this emotion is also automatic. For example, when aroused by a painful stimulus, the experience of the physiological sensation followed by that stimulus and the subsequent behavioral reaction are nearly simultaneous. However, higher level processing allows emotional experience to be goal-directed, rather than automatic. Denham (2007) states that the experience of emotions is not only the awareness and recognition of the experience, but how its expression will result in given outcomes. While lower level processes may cause one to retreat from a painful or aversive stimulus, higher level processes may inhibit this response in order to facilitate goal-directed behavior. For example, children learn to endure the pain of an injection because it has been reinforced through praise or promise of a reward. Shifting one's emotional experience from low level processes to higher level processes involves first the recognition of that experience. By identifying that one's internal state has been altered by some stimulus, it stymies the automatic response to this stimulus. Providing visual labels for nonverbal beings to identify the relationship between a stimulus and an internal state paves the way for goal-directed emotional experience.

Emotional competence is one of the chief facets of child development, defined as the ability to express emotions that are or are not experienced, regulating emotions, and decoding emotions in oneself and others. Emotional competence has been linked to academic success and positive social relations (Denham, 2007). Children who are emotionally competent are able to not only express their emotions, but use regulation and identification to create and promote growth of social relationships. Children unable to express emotions or regulate them as is socially appropriate are predicted to have behavioral problems and difficulty in school (Denham, 2007). The development of emotional competence is essential for children to form healthy peer relationships and navigate their way through a complex social environment.

The ability to discriminate between emotional expressions in faces arises in early infancy. Five month old infants were able to discriminate between happy and angry expressions (Siegler & Alibali, 2005). However discrimination of emotional expressions does not imply that infants are emotionally competent. This is developed largely through interpersonal interaction, first through caregivers and later through interactions with peers (Denham, 2007). The first step children take to reaching emotional competence is that of learning to identify an intrinsic emotional experience, also known as emotion labeling. Emotion labeling involves pairing verbal—and sometimes visual—stimuli with internal or physiological sensations. Children cannot acquire emotion labels without explicit instruction and contingent interaction with a caregiver. For example, a parent may eat a piece of candy and tell the child “Candy makes me feel happy.” Then, when the parent gives the child a piece of candy, they ask “Does this make you happy, too?” Ideally, after a few repetitions, the next time a child receives a piece of candy, she will label her happiness verbally without prompt. Acquisition of these labels tends to parallel linguistic development (Denham, 2007) so that basic labels—happy, sad, angry—are developed in early childhood. Just like with any kind of associative learning, a child’s emotion label repertoire and ability to discriminate between similar internal sensations develops with age. A four year old may describe feeling “sad” at the death of a close loved one, while a twelve year old would describe feeling “devastated” and even “listless”. Because language is often needed for the development of emotional labeling, and therefore emotional competence, those with limited or no verbal abilities frequently experience problems expressing and regulating their emotions (Denham, 2007). Although emotional deficiencies and autism spectrum disorder are often attributed to an inability to empathize, the language barrier of children with ASD also presents a problem in their development of emotional competence. Children with autism show significantly decreased usage in emotion language, but not other internal state languages such as thoughts and perceptions. For typically developing children, emotion was the second highest internal state language used (Kaushcke, van der Beek & Kamp-Becker, 2016). In fact, having a strong emotional vocabulary is linked to greater academic achievement, less engagement in destructive behavior, and an ability to tolerate frustration better than those who have a limited emotion vocabulary (Brogle, Jiron & Giacomini, n.d.). The best way to build a child’s emotional vocabulary is to talk about emotions not only when the child experiences them, but by using hypothetical examples in books or other learning mediums.

However, verbal labels are not the only way to teach a child to identify his and other’s emotions; visual labels are immensely helpful as well. In actuality, a combination of verbal and visual labels results in the best development of emotional competence, especially because visual labels allow a child to identify emotions in others based on facial expressions. In classroom settings, facial stimuli (such as a happy face) are often used to help children identify and express emotions. While verbal labels are definitely important, a child’s linguistic abilities are not wholly correlated with their emotion knowledge. Rather, the amount of time a mother spends expressing and labeling emotions—whether using verbal or visual stimuli—is a good indicator of a child’s emotional competence (Denham, 2007). Expressive patterns of others are also associated with children's ability to understand other's emotions. For example, a teacher may hold up a schematic happy face and say "I'm happy" or a schematic sad face and say "I'm sad" to facilitate a child's understanding of expressiveness. So, even a child with verbal deficiencies can learn to identify and express his emotions and those of others with the appropriate amount of interpersonal interaction. The use of visual labels can facilitate this development even more.

Without an alternative intervention (e.g., visual labels), children that lack verbal skills will likely show deficits in labeling and expressing their emotions. Autistic children have been shown to have a deficit in recognizing emotions in others and responding to their emotional expressions in a socially desirable manner (Crawford, Moss, Anderson, Oliver, & McCleery, 2015). This, in turn, seriously limits their social abilities, academic success, and ability to form friendships. Children with ASD are able to discriminate facial expressions just as well as typically developing children (Crawford et. al., 2015). Thus, the lack of emotional competence most likely does not stem from an inability to discriminate between different emotional expressions, but an inability to learn about the relationship between these expressions and the internal emotional state of the actor. Interventions with children with ASD involve learning about the relationship between their own internal state and a verbal label or visual expression. An additional step is to learn to generalize the label to the expression of emotion in others, and then lastly to generalize the internal emotional state to those exhibiting an emotional expression.

Nonhuman animals also face a difficulty in labeling emotions because of verbal limitations. Interestingly, there are neurobiological similarities between human and nonhuman animal reactions to "emotional" stimuli. For a human, exposure to an emotional stimulus—a grizzly bear, for instance—arouses an internal state labeled "fear" that motivates one to flee. Using fear conditioning, a rat exposed to a shock learns to move to the other side of the chamber to avoid it. For both humans and nonhuman animals, exposure to an emotional stimulus—especially an aversive one—results in increased activity in the amygdala (Phelps & LeDoux, 2005). Activation of the amygdala leads to an automatic response without awareness. For both humans and nonhuman animals, emotional arousal produces biases that result in an increased attention to emotional stimuli in the future (Phelps and LeDoux, 2005). While animal studies often investigate lower processes of emotional experience—such as amygdala activation in fear responding—the amygdala can send and receive information with both subcortical and cortical structures. Although the amygdala can receive sensory information via a "crude but rapid" input from the sensory thalamus, it can also receive a slower but more veridical representation from the sensory cortex (Phelps and LeDoux, 2005). The latter pathway is required for more complex stimuli and often inhibits the automatic emotional response found in lower processing. These two pathways show that emotion processing is not entirely subconscious for nonhuman animals.

Emotional stimuli are not just unconditioned stimuli that predict danger or food, but can be conditioned stimuli as well. For humans, the emotional expression of fear arouses the experience of fear itself, without any real danger. Similarly, a tone that has been paired with shock causes the same rates of activation in the amygdala of rats as the shock itself (Phelps & LeDoux, 2005).

Because the amygdala is largely responsible for the experience of emotions in human and nonhuman animals, damage to this region of the brain leads to impaired reactions to emotional stimuli. In humans, damage to the amygdala is associated with an inability to interpret facial expressions (Phelps & LeDoux, 2005). During a Theory of Mind task in which participants were asked to judge a person's emotions and intentions based on their facial expressions, adults with ASD showed no activation of the amygdala (Baron-Conen, Ring, Bullmore, Wheelwright, Ashwin & Williams, 2004). This implies that these expressions did not elicit the arousal of normal emotional stimuli. The left amygdala in particular is involved in identifying mental states and emotional information from complex visual stimuli. So, even using natural expressions to help label emotions may not result in successful emotion identification in children with autism. Instead, the use of simple—rather than complex—visual stimuli, may result in the development of emotional labels in children and adults with ASD.

It has been shown that nonhuman animals respond to unconditioned and conditioned emotional stimuli in much the same way as humans. However, are nonhuman animals capable of discriminating between internal sensations and varying their behavior accordingly? If so, then nonhuman animals meet the criteria for emotion labeling. Several studies—called drug discrimination studies—have demonstrated that nonhuman animals can learn to respond differentially to the internal state produced by a psychoactive drug or by saline. For example, scientists have trained nonhuman animals to respond to one of two visual stimuli for reward following injections of cocaine, which altered their physiological state (Colpaert, 1978; Griffiths, Roache, Ator, Lamb & Lukas, 1985; Overton, 1977). When injected with saline, subjects were rewarded for responding to the other visual stimulus. The external stimuli of the injection, the testing chamber, and the visual stimuli were held constant. During testing, several different species—pigeons, rhesus monkeys, rats—were able to discriminate between which stimulus would result in reinforcement based on their internal state (Lubinkski & Thompson, 1987). These drug discrimination studies mirror human emotion behaviors because the arousal from an emotional stimulus causes an internal state that drives a discriminative, goal-directed behavior, which results in reinforcement of some kind.

Further, Lubinski and Thompson (1987) trained pigeons to “express” their internal state to other pigeons with just the presence of a generalized conditioned reinforcer. First, pigeons were trained to peck a key with the corresponding interoceptive state based on an injection of a stimulant, a depressant, or saline. A peck to the correct key resulted in the illumination of a blue light (generalized conditioned reinforcer) which indicated that a response on the lever would result in reinforcement. After, they trained a pigeon in a separate but visible chamber to respond to a key marked “How do you feel?”, which would illuminate the three interoceptive keys for the other pigeon. Then, after the injected pigeon responds, a “Thank You” key is illuminated in the other pigeon’s chamber. A peck to the “Thank You” key results in access to reinforcement and the blue light being illuminated for the injected pigeon, which also indicates reinforcement. This experimental procedure represents a contingent interaction based on the expression of one’s internal states, just as the parent asks the child, “Does candy make you happy?”. Ideally, when teaching a child to label and express his or her emotions, reinforcement will shift from tangible reinforcers to more generalized ones, like positive social interaction. Later, the child’s expression of happiness is not limited to receiving candy, but perhaps to engaging in play with a friend. Similarly, pigeons continued to converse and express interoceptive states externally with just the presence of the blue light and no opportunity for reinforcement (Lubinkski & Thompson, 1987).

In contradiction to Thompson and Lubinski’s (1987) study, Savage-Rumbaugh (1984) put forth the criticism that expression of emotions is linguistically bound. Because the pigeons’ conversation was electronically sustained and not a wholly inter-species exchange, she claimed that it did not accurately represent human verbal conversation. However, Thompson and Lubinski (1987) argue that because the task was completed even without unconditioned reinforcement, the pigeons’ behavior very much resembled Savage-Rumbuagh’s (1984) definition of human conversation, which is maintained by generalized conditioned reinforcers as well. In all actuality, the mediation of nonhuman animal interactions by technology allows for more investigation into covert behaviors than science has had access to before. In fact, Skinner (1953) claimed that the "problem of privacy", the boundary between public and private events, may "be solved by technical advances". To draw further similarities between nonhuman animals' and children with autism's expression of internal states, it has been demonstrated that computer-based intervention drastically improves children with ASD's abilities to discriminate and identify facial expressions (Hopkins, Gower, Perez, Smith, Amthor, Wimsatt & Biasini, 2011). Thus, electronically sustained communication may allow for communication in nonverbal subjects that accurately mirrors human verbal expressions of emotion.

Humans and nonhuman animals also show similarities in the visual processing of human facial expressions. When processing the identity of a face, it does not matter what expression is on that face. Humans accurately identify the identity of a face whether it is expressing happiness, sadness, disgust or anger. However, when humans are processing the expression a face is displaying, the identity of that face is processed as well. This suggests not only that facial identity and emotional expression are processed in different parts of the brain, but also that the processing of expressions affects the perceptions of the identity, and vice versa. For example, a man with a neutral expression may be judged as angry, while a woman with the same expression may be judged as happy. Thus, variations in identity effect classification of expressions, but variations in expression do not effect classification of identity. In a study of a collection of various human expressions and identities, pigeons reflected this same visual asymmetry (Soto & Wasserman, 2011). This supports a generalized process approach of visual perception of expressions. Particularly pertinent to this study is the similarity of visual perception of facial expressions between pigeons and children with autism. Jitsumori and Yoshihara (1997) demonstrated that pigeons can discriminate between natural facial expressions, including happiness and anger. Furthermore, when they manipulated either the upper half or the lower half of the expression, they found that pigeons discriminate expressions based on the mouth region of the face. This suggests that, unlike humans, pigeons do not process faces holistically, but rather as an additive integration of individual features. This is further supported by the fact that the pigeons didn't have any trouble categorizing the expressions when the features were inverted (Jitsumori & Yoshihara, 1997). Similarly, autistic children discriminate facial expressions based on the mouth region, and show impaired discrimination abilities when exposed to just the upper features (Joseph & Tanaka, 2003). Children with ASD also show no impairments when exposed to inverted features, which suggests that they also do not process faces holistically. These abundant similarities between nonhuman animals and children with ASD support the claim that the results of this study could be used to approach teaching emotion labeling to nonverbal beings.

The current study is interested in whether typically developing humans can learn the relationship between a particular visual stimulus with a corresponding internal state. After the alteration of subjects' internal state, they will be presented with two visual stimuli (basic, colored shapes). These visual stimuli act as labels for the subjects' corresponding internal state; should humans be successful in learning the relationship between the visual stimulus and the elicited internal state, then this effect will be demonstrated in a transfer test in which exposure to a new emotional stimulus should result in responding to the correct visual label based on whether or not it is followed by reinforcement.

Experiment 1

Methods

Participants. There were 28 participants (15 males and 13 females), all of which were ages 18 or older. Participants were all undergraduate students at Texas Christian University and were recruited via SONA, the Psychology Research Participation System. At the end of the experiment, all participants received $10 in U.S. currency, regardless of performance.

Materials. The study was conducted via a computer program coded through *Visual Basic 6.0*. Participants completed the program on an *HP All-in-one touchscreen-equipped computer*, and were given *Sony ZX Series On-Ear* headphones which played continuous white noise. Five 5 cm circular stimuli were used, and appeared at three different locations on the computer screen. The three circles assigned as discriminative stimuli were white with a black pattern (dot, checkerboard, and grid), and all appeared at the top center of the computer screen. The remaining two circles were assigned as visual labels. They were solid colored circles (peach and teal) and alternated between the bottom left and right of the computer screen. A 7 cm rectangular stimulus depicting paper currency and coins appeared on the screen periodically was intended to serve as a reinforcer. A 5 cm filled (black) circle with a white border appeared at the top center screen during the intertrial interval (ITI), which is the time from the end of the previous trial to the start of the next trial. Finally, a red rectangle with a yellow slider spanned the right side of the computer screen. The yellow slider filled upwards to and represented “points” (reinforcers earned) earned throughout the task.

Design. This experimental procedure included a within-subjects design, with factors Trial Type and Phase (Training vs. Testing). All participants were exposed to the same number of training and testing trials, but the order of trials was counterbalanced across subjects. There was no mastery to criterion component to continue to later phases. All subjects completed a set number of trials and then advanced to the next phase.

Procedure.

Pretraining. Pretraining for participants included a practice program which contained three 5 cm circles (pretraining stimuli that were not used in subsequent training), the rectangular icon depicting money, and the hollow circle indicating an ITI. No visual label stimuli were included in the pretraining program. Touches to the circular stimuli were reinforced on FR1 and RR2 schedules. This allowed participants to navigate the program and become familiar with its components before beginning the experiment.

Instructions. The experimenter read a script to participants before and after completion of pretraining. The script emphasized paying attention to the order of events to earn points, but did not give details about the experimental design (See Appendix A).

Training. At the beginning of every trial, participants were presented with a training, transfer-partial, or transfer-continuous visual discriminative stimulus. For the training stimulus, a trial terminated after a touch to the stimulus with reinforcement 50% of the time and terminated with non-reinforcement during the remaining 50%. An event of reinforcement was defined as a discriminative stimulus followed by money, and an event of non-reinforcement was defined as a discriminative stimulus followed by no money. Reinforcement was quantified as points, which participants were told could be exchanged for money; all participants were actually given the same amount, $10. Once the event of reinforcement or non-reinforcement occurred following the presentation of the training stimulus, participants were presented with two visual labels. A touch to the teal or peach visual label would advance the program depending on whether or not reinforcement preceded the labels. If reinforcement had occurred, a correct response was defined as a touch to one label (e.g., teal label). A correct response following non-reinforcement was defined as a touch to the other label (e.g., peach label). During training, a touch to the wrong visual label resulted in a 2-s delay, in which both labels turned gray. After the delay, the labels returned to their original color and the reinforcement schedule was reset.

On trials with the transfer-partial stimulus, a touch was also followed by reinforcement on 50% of trials. However, these trials never included subsequent exposure to the visual labels. On trials with transfer-continuous stimulus, a touch to the stimulus resulted in reinforcement after every trial and no visual labels were presented.

Training consisted of three phases containing 20 trials per phase, which totaled 60 training trials. Phase 1 was reinforced on an FR1 schedule, in which only one touch was required to advance the program. Phase 2 was reinforced on an RR2 schedule, in which each response was equally likely to move the program along, and an average of two touches was successful in doing so. Phase 3 was reinforced on a RR2 + FI2 combination schedule, in which two seconds passed before an average two touches was successful in program advancement. Trials types were randomized across phases. All trials timed out after 30 s.

Testing. Testing consisted of two phases of 21 trials, which totaled 42 testing trials. Just as in training, participants were presented with training, transfer partial, and transfer continuous discriminative stimuli. However, all discriminative stimuli were followed by events of reinforcement or non-reinforcement. Then, the event of reinforcement or non-reinforcement was followed by one of three visual label combinations: teal/peach, teal/teal, and peach/peach. Additionally, a fourth testing trial included an ITI, followed by one of three label combinations. Responses during testing were always reinforced based on an FR2 + FI2 schedule, where responses to either visual label were counted as correct. This non-differential reinforcement procedure was meant to prevent learning during test trials, but rather, maintain behavioral tendencies established during training. Trial types were defined by the type of discriminative visual stimulus presented (training, partial, continuous, ITI), the event of reinforcement or non-reinforcement (money or no money), and the combination of visual labels presented (TP, TT, PP).

Results

Of 23 total participants, eight were excluded from analyses because they did not respond during at least one test trial. In the analyses below, Trial Type A refers to the discriminative stimulus that was followed by labels during training, B refers to the discriminative partially reinforced stimulus, and C refers to the discriminative stimulus that was continuously reinforced.

The training data were analyzed to determine whether participants learned to label their experience on trials of A-reinforced and A-non-reinforced. An analysis of variance was used to determine whether any differences in learning existed between the two training trials with stimulus A. A 3 (Phase: 1, 2, vs. 3) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects analysis of variance (ANOVA) calculated participants' first responses to choice labels during the two training trials of A. No main effects or two-way interactions were significant, *F*s > .40, *p*s > .40 (See Table 1 for Descriptive Statistics). Several *t*-tests against a constant examined whether participants' first response was to the correct choice label during training trials. The constant was selected as .5, which represented chance performance (e.g., two labels were present during test trials). All tests were non-significant, *t*s > -1.50, *p*s > .20. These results indicate that participants did not display acquisition of the task during training.

The test data were analyzed in the same manner. A 3 (Trial Type: A, B, vs. C.) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects ANOVA was conducted on participants' first responses to choice labels during test trials. There was no effect of trial type, $F(2, 28) = .64$, $p = .54$, or outcome, $F(1, 14) = .67$, $p = .43$(See Figure 1). Finally, there was no significant two-way interaction, $F(2, 28) = .08$, $p = .97$. Dependent *t*-tests examined participants' first responses during training trials as a function of chance performance. All tests were non-significant, *t*s > -1.50, *p*s > .30. Results indicate that participants performed at chance levels among all trials, and therefore did not learn the task.

It could be the case that first response data does not fully capture what a participant has learned. Participants were given 4 s to make as many responses as possible. This analysis includes all of the responses made during the 4 s test trials. A 3 (Trial Type: A, B, vs. C) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects ANOVA was performed on proportion correct of all responses during test trials. No main effects or two-way interactions were significant, *F*s > .01, *p*s > .50 (See Table 2 for Descriptive Statistics). Dependent *t*-tests examined proportion correct of all responses during test trials as a function of chance performance. All tests were non-significant, *t*s > -1.00, *p*s > .40.

Finally, a similar ANOVA was conducted on participants' average latency for first responses during test trials. No main effects or two-way interactions were significant, *F*s > .01, *p*s > .07 (See Figure 2). Participants responded in the same amount of time across trial types.

Experiment 2

Methods

Participants. There were 10 Participants (1 male and 9 females), all of which were ages 18 or older. Participants were all undergraduate students at Texas Christian University and were recruited via SONA, the Psychology Research Participation System. At the end of the experiment, all participants received one hour of study credit, regardless of performance.

Materials. All materials were identical to those used in Experiment 1, with the exception of the following three program additions. 2 5 cm square stimuli were assigned as visual labels, were solid colors (peach and teal), and appeared at either the bottom left or the bottom right of the computer screen. A 5 cm white "plus" sign designated the ITI, and appeared at the top center screen. A tone resounded with each press, regardless of whether or not the response was correct.

Design. The within-subjects design with Phase and Trial type as factors was the same as in Experiment 1.

Procedure.

Pretraining. The pretraining procedure was the same as in Experiment 1.

Instructions. Rather than the experimenter reading the script, participants were instructed to read a script containing instructions for the experimental program. The experimenter re-iterated important aspects of the script (See Appendix A).

Training. At the beginning of every trial, participants were presented with one of three visual discriminative stimuli: training, transfer-partial, and transfer continuous.

Training consisted of six phases, totaling 80 training trials. Phases 1, 2, and 3 were reinforced on FR1, RR2, and RR2 + FI2 schedules respectively. The phases contained a combined total of 40 trials. During these phases, the discriminative training stimulus was only followed by the correct label, associated with the preceding event of reinforcement or non-reinforcement. In other words, during Phases 1-3 there was no choice between labels, only the correct label was presented. Phases 4, 5, and 6 were reinforced on FR1, RR2, and RR2 + FI2 schedules respectively. The phases contained a combined total of forty trials. These trials did include a choice between two labels following discriminative training stimulus trials. For all phases during training, stimulus partial and stimulus continuous trials did not include labels. Trials types were randomized across phases. All trials timed out after thirty seconds.

Testing. Testing consisted of two phases containing 21 trials per phase, which totaled forty-two testing trials.

Results

No participants were excluded from analysis. In the analyses below, Trial Type A refers to the discriminative stimulus that was followed by labels during training, B refers to the discriminative partially reinforced stimulus, and C refers to the discriminative stimulus that was continuously reinforced.

The training data were analyzed to determine whether participants learned to label their experience on trials of A-reinforced and A-non-reinforced. An analysis of variance was used to determine whether any differences in learning existed between the two training trials with stimulus A. A 3 (Phase: 4, 5, vs. 6.) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects analysis of variance (ANOVA) was conducted on participants' first responses to choice labels during training. No main effects or two-way interactions were significant, Fs > .01, ps > .30 (See Figure 3). Dependent t-tests for first responses during training trials were conducted against chance performance. Participants performed significantly lower than chance in Phase 6 non-reinforced trials with discriminative stimulus A, $t = -3.25$, $p = .010$. All other comparisons were non-significant, *t*s > -1.00, *p*s > .30. Results indicate that participants did not acquire the task during training with choice labels.

The test data were analyzed in the same manner. A 3 (Trial Type: A, B, vs. C) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects ANOVA was performed on proportion correct of participants' first responses during test trials. There was a main effect of outcome, $F(1, 9) = 7.36$, $p = .02$ (See Figure 4), with performance on reinforced trials ($M = .50$, $SE = .04$) being significantly higher than performance on non-reinforced trials ($M = .40$, $SE = .05$). However, there was no effect of trial type, $F(2, 18) = .61$, $p = .56$, and no two-way interaction, $F(2, 18) = 1.10$, $p = .35$. Dependent *t*-tests were also conducted on participants' first response during test trials. Tests revealed that performance on trial types A-non-reinforced and C-non-reinforced were marginally lower than chance levels, *t*s = -1.96, *p*s = .081. All other tests were non-significant, *t*s > -.50, *p*s > .50. These results suggest that participants performed marginally worse on non-reinforced trial types A and C, while performance on all other trial types was at chance. Once again, they did not demonstrate any learning.

A 3 (Trial Type: A, B, vs. C) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects ANOVA was performed on proportion correct of all responses during test trials. No main effects or two-way interactions were significant, *F*s > .30, *p*s > .20 (See Table 3 for Descriptive Statistics). Dependent *t*-tests examined proportion correct of all responses during test trials as a function of chance performance. All tests were non-significant, *t*s > -1.50, *p*s > .15.

A similar ANOVA was conducted on average latency of first response during testing trials. All main effects and two-way interactions were non-significant, Fs > .20, ps > .40 (See Figure 5). Participants responded just as quickly across all trial types and outcomes.

Experiment 3

Methods

Participants. There were 23 participants (4 males and 19 females), all of which were ages 18 or older. Participants were all undergraduate students at Texas Christian University and were recruited via SONA, the Psychology Research Participation System. At the end of the experiment, all participants received one hour of study credit, regardless of performance.

Materials. All materials were identical to those used in Experiment 2, with the following exception. There were three new circles assigned as discriminative stimuli and were white with a black pattern (teepee, zig-zag, and target).

Design. The within-subjects design with Phase and Trial type as factors was the same as in Experiment 1 and Experiment 2.

Procedure.

Pretraining. Pretraining for participants was the same as in Experiment 2, with the following exception. Additionally, trials with one visual label or two visual labels were included in the pretraining program. These squares were purple and green, so as to differentiate them from the peach and teal labels used in the actual experiment. Touches to the circular and square stimuli were reinforced on FR1 and RR2 schedules.

Instructions. Participants were given a script which explicitly described the outline of the experiment. They were told that there were events of money and no money, which were meant to represent reinforcement and non-reinforcement, respectively. They were also told that the squares were meant to act as labels for these events. They were not told, however, that they were expected to transfer these stimuli to novel situations during testing (See Appendix A).

Training. Training was the same as in Experiment 2.

Testing. Testing was the same as in Experiment 2.

Results

No participants were excluded from analysis. In the analyses below, Trial Type A refers to the discriminative stimulus that was followed by labels during training, B refers to the discriminative partially reinforced stimulus, and C refers to the discriminative stimulus that was continuously reinforced.

The training data were analyzed to determine whether participants learned to label their experience on trials of A-reinforced and A-non-reinforced. An analysis of variance was used to determine whether any differences in learning existed between the two training trials with stimulus A. A 3 (Phase: 4, 5, vs. 6.) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects analysis of variance (ANOVA) was conducted on participants' first responses to choice labels during training. There was neither an effect of phase, $F(2, 44) = .01$, $p = .99$, nor an effect of outcome, $F(1, 22) = .95$, $p = .34$ (See Figure 6). Likewise, these results were not qualified by a two-way interaction, $F(2, 44) = .09$, $p = .91$. Dependent t-tests examined first responses during training against chance performance. Tests revealed no significant comparisons, ts > .01, ps >

.20. Results indicate that participants did not display acquisition of the task during training with choice labels. However, it should be noted that four participants chose the correct label above chance (.50) on both kinds of training trials.

A 3 (Trial Type: A, B, vs. C) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects ANOVA was performed on participants' first responses during test trials. No main effects or two-way interactions were significant, Fs > .40, ps > .30 (See Figure 7). Dependent t-tests examined first responses during test trials against chance performance. Tests found that participants did not perform significantly above or below chance in any test trial, ts > -1.50, ps > .20. Participants did not display any learning of the task. However, it should be noted that one of the four participants that learned the task answered correctly on all test trials.

A 3 (Trial Type: A, B, vs. C) x 2 (Outcome: reinforced vs. non-reinforced) within-subjects ANOVA was conducted on proportion correct of all responses during test trials. There were no significant effects or interactions, Fs > .90, ps > .20 (See Table 4 for Descriptive Statistics). The same participant with perfect scores on the first response also performed very well when all responses were analyzed (>.80 on all test trials). Dependent t-tests also showed that performance among all trial types was not significantly difference than chance levels, ts > -.50, ps > .10.

Finally, a similar ANOVA tested participants' first response latency during test trials. All main effects and interactions were non-significant, Fs > .01, ps > .70 (See Figure 8). Participants responded to all test trials in the same amount of time.

Discussion

We hypothesized that participants would learn to label events of reinforcement and non-reinforcement with visual stimuli. Training included exposure to the training stimulus, followed by events of money or no money, and finally a choice between two visual labels. It was predicted that the use of visual labels for events of reinforcement and non-reinforcement would transfer to novel situations.

Results indicated that participants were unable to learn the task, and were therefore unable to label emotional events with visual stimuli. Even when participants were explicitly told the purpose of the experiment and the intricacies of the design (Experiment 3), they still failed to accurately label events of reinforcement and non-reinforcement. These results may be evidence for the immense difficulty of identifying and discriminating one's internal sensations without explicit verbal instruction.

Participants in Experiment 1 performed at chance levels across training and testing trials. That is, regardless of the event of reinforcement or non-reinforcement, their choice of label was entirely random. Response accuracy across trial types was equal, indicating that participants not only failed to transfer response contingencies from the discriminative training stimulus to transfer partial and transfer continuous test trials, but they failed to learn any response contingencies at all. The data reveal that only one participant scored above chance on both types of trials with A during training, but they failed to perform accurately on the test trials.

There are several reasons why participants in Experiment 1 may have failed to learn to label their experience. First, both the discriminative stimuli and visual labels were represented by circles. We hypothesized that multiple circular stimuli made it difficult for participants to distinguish precedents for emotional events (discriminative stimuli) and labels for emotional events. Second, participants never received training trials where only the correct labels followed the event of reinforcement or non-reinforcement. The lack of training in which participants were only ever exposed to both labels at once could have caused the deficit in acquisition of the task. This does not mirror the typical situation of learning to label emotions, which is first facilitated by explicit instruction. In other words, a single, correct label is initially provided, rather than a choice between a correct and incorrect label. We addressed both of these problems in Experiment 2.

In Experiment 2, the visual labels were changed to squares, to further distinguish them from the circular discriminative stimuli. We increased training by adding twenty training trials to the previous sixty trials, and the first 30 trials included only the correct label following the event of reinforcement or non-reinforcement. Ideally, these additional training trials would help establish event-label associations, and would transfer to training and testing trials with a choice between two labels. Despite these changes, group performance was still no better than chance. Even in the last training phase (Phase 6), all participants were still performing at chance levels. During testing, response accuracy was significantly better with reinforced trials as compared to non-reinforced trials. There is no obvious reason for this difference – it may simply represent a bias of this particular group of participants. This is supported by the absence of this effect in Experiment 1 and 3. Discriminative training and transfer continuous non-reinforced trials were marginally below chance levels, but performance on other trials was still at chance. Overall, participants again failed to learn the task, and instead appeared to choose each label randomly.

The failure to again find evidence of labeling of an experience led us to further analyze our procedure. It was noted that the differences between the black and white patterns of the discriminative stimuli were only slightly discernible, which could have caused participants difficulty in treating these stimuli as three separate events. The pretraining program in Experiments 1 and 2 did not include labels, and so participants' first exposure to them was when the experimenter had already vacated the room in which the study was conducted. The pretraining program did not mirror the actual procedure to which participants were exposed. Lastly, we hypothesized that perhaps the experimental paradigm was not adequately communicated. We again took steps to remedy these problems.

In Experiment 3, the pattern of the discriminative stimuli was changed to black line drawings against a white background. While these drawings were not likely to represent a familiar object in participants' concept repertoire, they were more easily discernable from one another. The pretraining program was updated to include correct label trials and choice label trials. Perhaps most importantly, participants were provided with explicit written and vocal instructions, which outlined the goal of the experimental procedure. They were told that they would experience emotional events in the form of the presence or absence of money, and that these events could be anticipated by the circle which preceded them. They were also told that the squares represented labels for these emotional events. While an experiential aspect of the experimental protocol was lost by giving participants explicit instruction, we were still able to evaluate whether the use of these labels could be transferred to novel situations. Specifically, transfer from training trials of stimulus A with labels to test trials of discriminative stimulus partial (B) and discriminative stimulus continuous (C). However, as a group the participants again failed to learn the task in Experiment 3. Although four participants' data did indicate successful learning during training, only one participant transferred learning to the new trial types. Their latency to make a choice did not differ across stimuli.

The results of the study illustrate the difficulty of labeling one's internal, physiological sensations with an arbitrary symbol. The advantage of language allows an additional cue to help one identify, discriminate, and act upon interoceptive sensations. The value of this skill holds untold leverage in navigating one's environment. Emotional competence increases interpersonal relations, and is associated with increased academic performance. This trait should be prioritized when considering a child's behavioral repertoire. Those children who are nonverbal often have decreased emotional competence, and therefore display deficits in forming relationships with peers and in academic performance (Denham, 2007; Brogle et. al., n.d.). Often, this deficit manifests itself in the most basic component of emotional competence: emotion labeling. If there is a procedure which is successful in using nonverbal stimuli to help externalize the experience of emotional sensations, it will begin the first step in developing emotional competence in these children.

It should be noted that all participants were recruited via SONA, a student research participation program led by the Psychology department at Texas Christian University. In exchange for their participation, the undergraduates were either given monetary compensation (Experiment 1) or extra credit toward their Psychology courses (Experiments 2 and 3). Because these rewards were only contingent upon attendance and participation in the experiment, not performance, it is possible that performance was not at optimal levels. That is, participants may have engaged in behaviors which resulted in the task ending more quickly, rather than paying attention to the instructions and consciously trying to learn the task. Participants were also from a small, restrictive sample. They were all undergraduate students from a private university, and distribution of age was small.

Many participants described the experimental process as tedious and repetitive, and most likely were not fully engaged in the task. This could have produced a decrement in learning. When one is learning to label emotions, it is often in an active environment filled with salient, relevant cues. When a child is startled by a loud noise, a parent may help them identify their increased heart rate as “fear”. In fact, research indicates that emotional competence is developed most through interpersonal interactions with a caregiver (Denham, 2007). This program was rather clinical in nature, and so may not have communicated the implications of the task as effectively.

The presence of an interoceptive reaction to an external stimulus is essential for learning to label these reactions. Some awareness of this physiological sensation is immensely helpful in learning to label emotions. It is possible that the pictorial representation of money failed to elicit a legitimate interoceptive response. Subsequently, without this internal sensation, all learning would thus be wholly external. The “points” were meant to facilitate continued reinforcement, but these may also have failed to elicit any physiological response. Therefore, increasing the salience of the events of reinforcement and non-reinforcement should foster the ability to label the sensations elicited by the external events.

It is suggested that future research in this paradigm be conducted with nonhuman animals. These subjects provide a unique construct in that they lack verbal abilities, and are not often exposed to the same level of verbal stimuli in their surrounding environment as humans. Additionally, the use of food delivery or absence as reinforcement is arguably more salient than a pictorial representation of money. By using stimuli which have biological significance, we can elicit more salient internal sensations in our subjects. Also, nonhuman animals would most likely be more motivated to learn the task with biologically relevant stimuli. It is predicted that nonhuman animals will be capable of emotion labeling because: humans and animals share neurobiological reactions to emotional stimuli (Phelps & LeDoux, 2005; Cohen et. al., 2004), nonhuman animals can vary behavior based on differing internal states (Lubinski & Thompson, 1987), and processing of emotional expression is supported by a general process approach (Soto & Wasserman, 2011).

Secondly, future research should focus on ways to make using visual labels more salient to typically developing children. Whether these approaches use color, shape, or other physical features to distinguish emotions, these labels should generalize to new situations and emotional events. Doing so will help create the foundation for introducing this concept to nonverbal children and adults.

To a greater extent, this study can help address emotion labeling issues in children with autism. It represents a visual, rather than a verbal, label for emotions. Also, visual stimuli in the form of happy and sad faces differ in the lower region—but not the upper region—of the face. This has been shown to facilitate the detection of an emotional expression by both individuals with ASD and pigeons. Thirdly, if autism is related to amygdala impairments, then the use of simple visual labels acquired through differential reinforcement is ideal, rather than using complex visual stimuli of natural facial expressions. Further, successful use of these simple visual labels by discriminating between the mouth regions could transfer to natural facial expressions, which have similar mouth shapes (the shape of an artificial smile and a natural smile indicating happiness are very similar). Finally, if nonhuman animals are capable of using emotion labels associated with naturally occurring internal states, then expression of these emotions based on contingent interaction is entirely possible. Ideally, if emotion labeling and expression of these emotions is eventually reinforced by social motivation, then emotional competence has been achieved.

Overall, using visual labels in place of verbal labels could help to eradicate the need for language to develop emotion identification, or even facilitate subsequent emotion labeling using vocal labels. Once one is able to label their emotions, he is able to generalize this label to other situations. Then, he can begin to act upon these emotions, and finally to regulate them. This, in turn, will improve one's attention to key internal cues, and will better help one navigate his environment accurately and effectively.

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Table 1. Means (*M*) and standard deviations (*SD*) on average correct of first responses during training trials. Training trials only included discriminative stimulus A.

	M	*SD*
Phase 1		
Reinforced	.47	.28
Non-reinforced	.52	.26
Phase 2		
Reinforced	.40	.35
Non-reinforced	.42	.26
Phase 3		
Reinforced	.42	.24
Non-reinforced	.53	.19

Table 2. Means (*M*) and standard deviations (*SD*) for proportion correct of all responses during testing.

Trial Type	*M*	*SD*
A-reinforced	.48	.17
A-non-reinforced	.46	.20
B-reinforced	.50	.23
B-non-reinforced	.51	.21
C-reinforced	.50	.27
C-non-reinforced	.52	.21

Table 3. Means (*M*) and standard deviations (*SD*) for proportion correct of all responses during testing.

Trial Type	*M*	*SD*
A-reinforced	.48	.25
A-non-reinforced	.42	.18
B-reinforced	.48	.19
B-non-reinforced	.48	.20
C-reinforced	.56	.24
C-non-reinforced	.49	.04

Table 4. Means (*M*) and standard deviations (*SD*) for proportion correct of all responses during testing.

Trial Type	*M*	*SD*
A-reinforced	.50	.29
A-non-reinforced	.56	.28
B-reinforced	.46	.36
B-non-reinforced	.47	.33
C-reinforced	.40	.31
C-non-reinforced	.57	.34

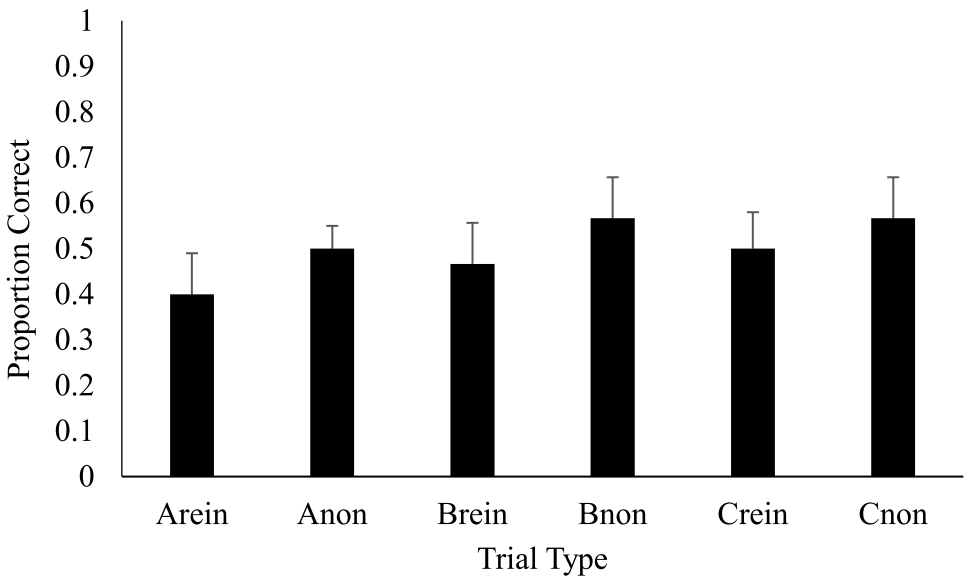

Figure 1. Average of correct first responses for test trials with choice labels. The first letter of the X-axis label refers to the discriminative stimulus present on that trial, “rein” refers to the delivery of reinforced following a touch to the discriminative stimulus, whereas, “non” refers to the omission of reinforcement following a touch to the discriminative stimulus. Error bars represent standard error of the mean. Chance performance at test is .5.

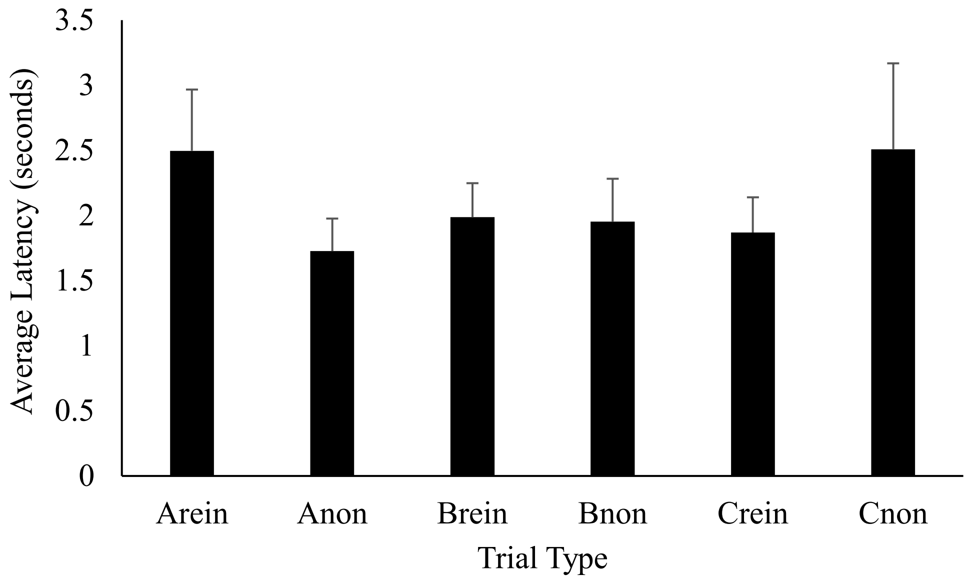

Figure 2. Average of first response latency for testing trials with blue/pink choice labels. The first letter of the X-axis label refers to the discriminative stimulus present on that trial, "rein" refers to the delivery of reinforced following a touch to the discriminative stimulus, whereas, "non" refers to the omission of reinforcement following a touch to the discriminative stimulus. Error bars represent standard error of the man. Chance performance at test is .5.

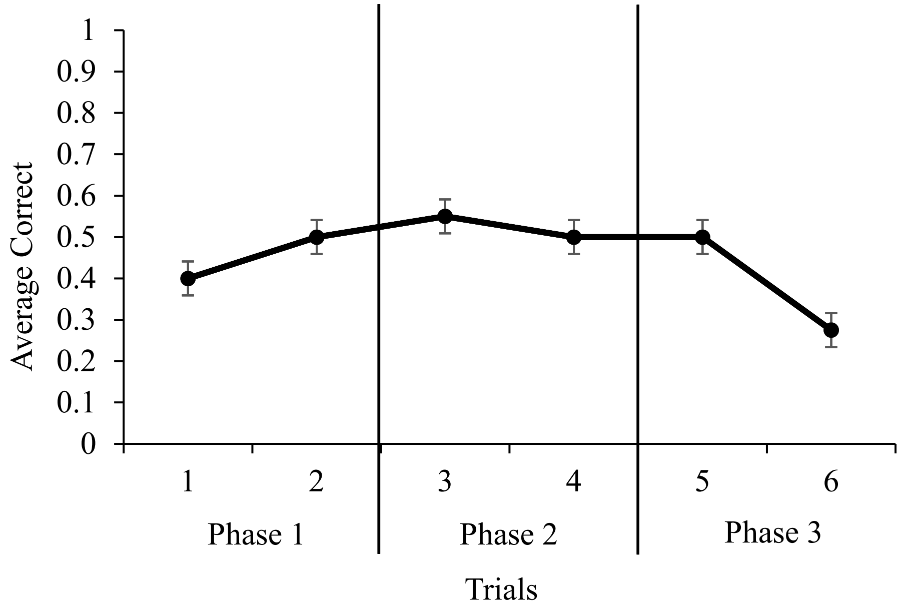

Figure 3. Average of correct first responses during training trials with choice between two labels. Training consisted of three phases in which participants were exposed to reinforced and non-reinforced trial in each phase, only with stimulus A. The progression of trials from 1-6 along the X- axis represents acquisition performance. Error bars represent standard error of the mean.

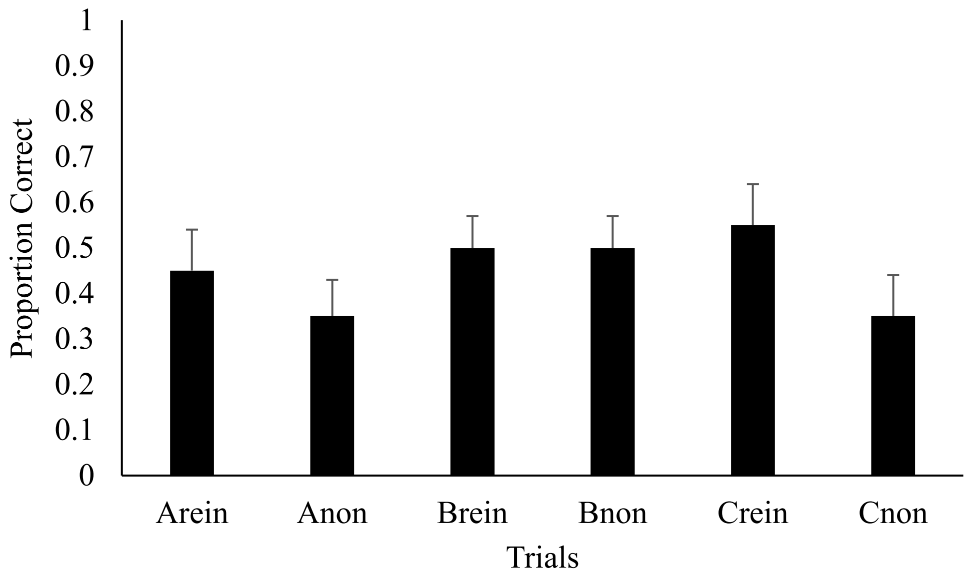

Figure 4. Average of correct first responses for testing trials with blue/pink choice labels. The first letter of the X-axis label refers to the discriminative stimulus present on that trial, "rein" refers to the delivery of reinforced following a touch to the discriminative stimulus, whereas, "non" refers to the omission of reinforcement following a touch to the discriminative stimulus. Error bars represent standard error of the mean. Chance performance at test is .5.

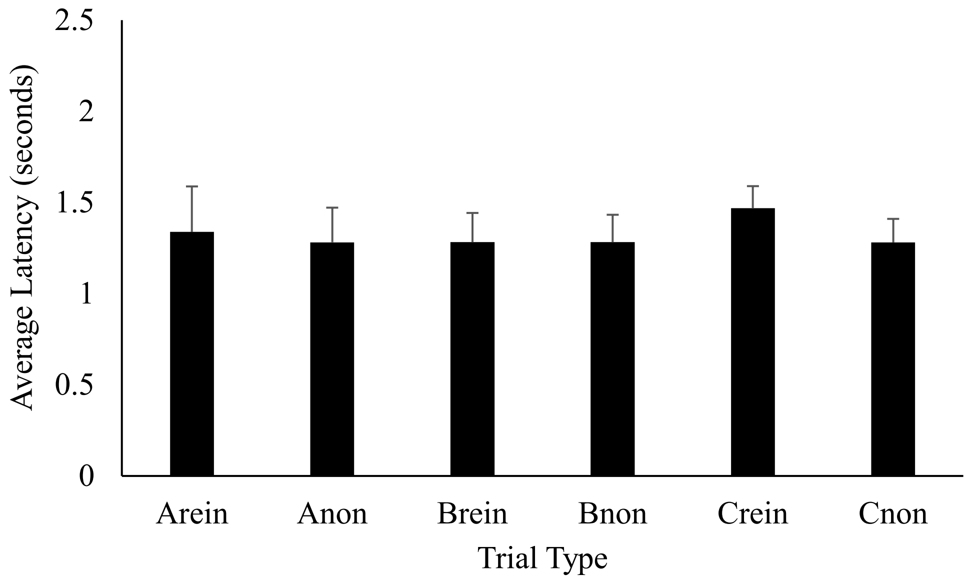

Figure 5. Average of first response latency for testing trials with blue/pink choice labels. The first letter of the X-axis label refers to the discriminative stimulus present on that trial, "rein" refers to the delivery of reinforced following a touch to the discriminative stimulus, whereas, "non" refers to the omission of reinforcement following a touch to the discriminative stimulus. Error bars represent standard error of the mean. Chance performance at test is .5.

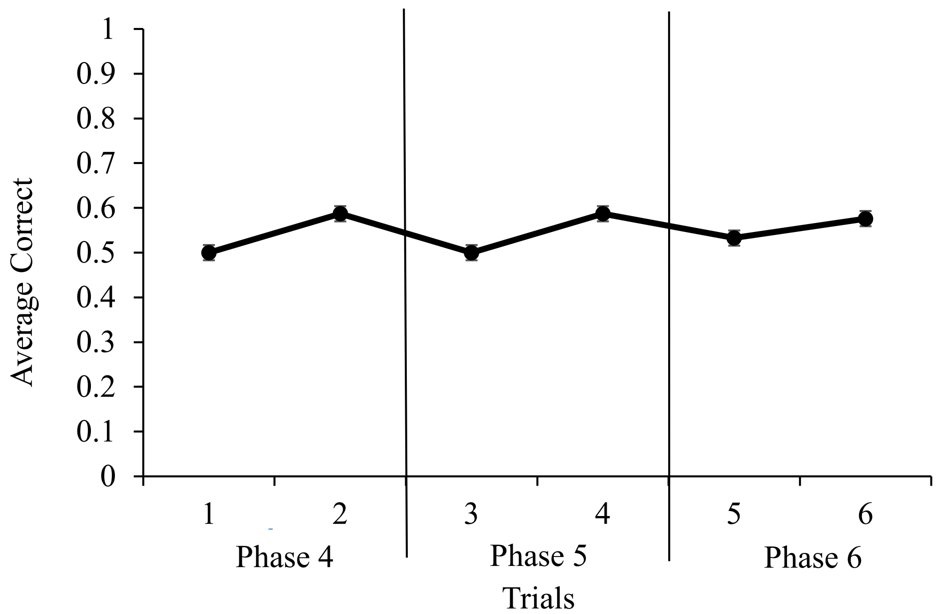

Figure 6. Average of correct responses during training trials with choice between two labels. Training consisted of three phases in which participants were exposed to reinforced and non-reinforced trial in each phase, only with stimulus A. The progression of trials from 1-6 along the X- axis represents acquisition performance. Error bars represent standard error of the mean.

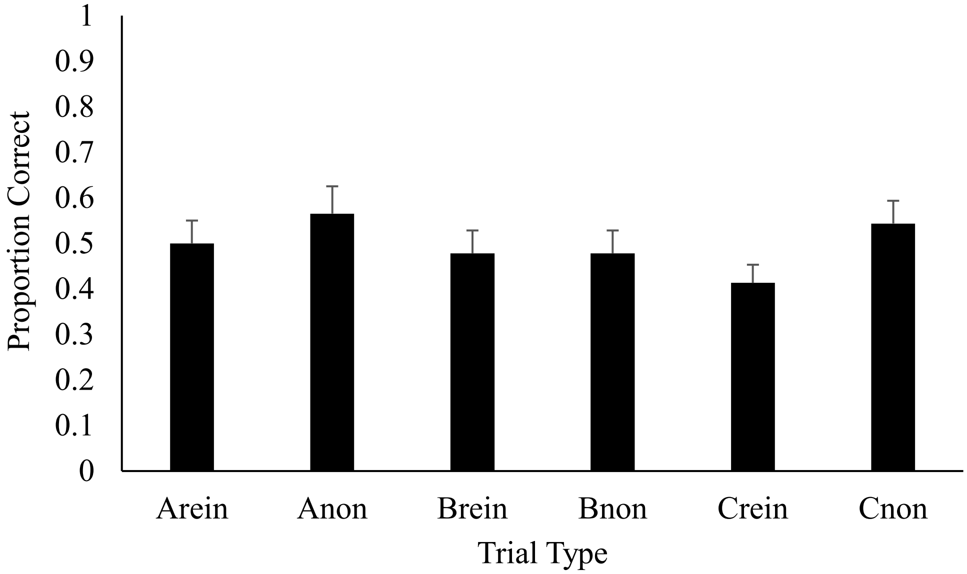

Figure 7. Average of correct first responses for testing trials with blue/pink choice labels. The first letter of the X-axis label refers to the discriminative stimulus present on that trial, "rein" refers to the delivery of reinforced following a touch to the discriminative stimulus, whereas, "non" refers to the omission of reinforcement following a touch to the discriminative stimulus. Error bars represent standard error of the mean. Chance performance at test is .5.

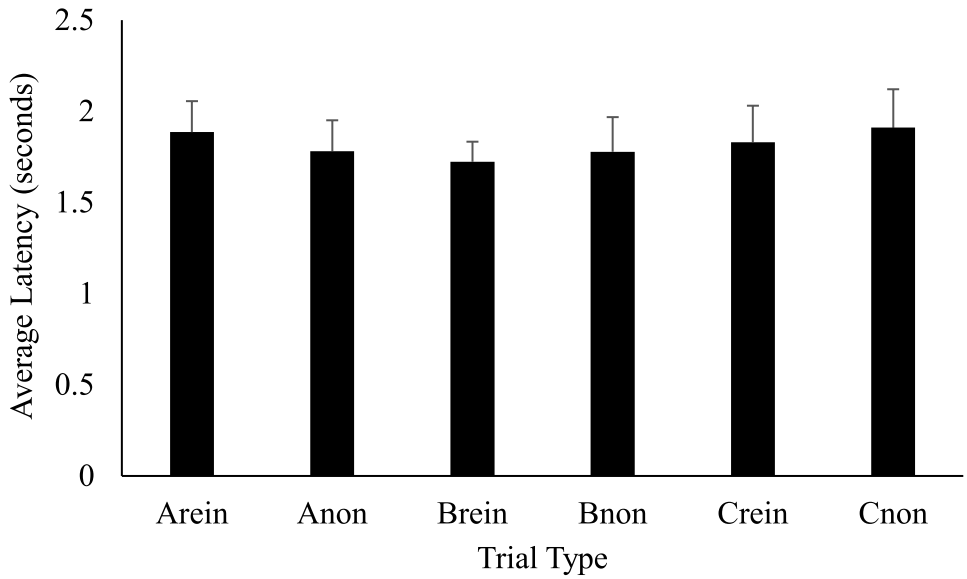

Figure 8. Average of first response latency for testing trials with blue/pink choice labels. The first letter of the X-axis label refers to the discriminative stimulus present on that trial, "rein" refers to the delivery of reinforced following a touch to the discriminative stimulus, whereas, "non" refers to the omission of reinforcement following a touch to the discriminative stimulus. Error bars represent standard error of the mean. Chance performance at test is .5.

Appendix A

Script of instructions for Experiment 1. Read by the experimenter.

Experiment 1 Script

Pretraining:

-Open the pretraining program and start the program.

On your screen, you will see a circle icon. By touching this icon and other icons that may appear on the screen, you can earn points. At the end of the session, however many points you earn will be translated into money. Your goal is to earn as many points as you can. At times only one touch will earn you a point, at other times many touches will be required. During the program there will also be times when a touch is required simply to move the program along to the next trial.

-Pause to let the participant complete three trials (one FR1, RR2, and then FR2+FI2). Ask if there are any questions? Read the following:

During this experiment, you will notice that some trials will be include more than one circle, and some trials will not. Your goal is to earn as many points as possible. This is a learning task. It is important that you **pay attention to the icons as they are presented**. This will help you to determine how to respond. A new trial will begin when the screen goes black, and a new circle icon will appear on the screen. By paying attention to the order of events, it is possible to earn the maximum number of points.

The Task:

-Open the Training program and start the program. Pause at the black screen and wait to hit "F10". Read the following:

Your goal is to earn as many points as possible. Keep in mind that a trial may require you to touch the icon several times before points are given. Pay close attention and **please do not press at random**. Incorrect responses will lengthen the time of the session, but no longer than the maximum 60 min.

Sometimes you will encounter new combinations of circles; you should still do your best to press use what you have learned to continue earning points. Do your best to respond as quickly and accurately as possible. Now, go earn some points!

Script of instructions for Experiment 2. Read by the participant.

Experiment 2 Script

Pretraining

On your screen, you will see a circle. When you touch the circle, other icons may appear on the screen. By touching the circle and other icons, you can earn points. Your goal is to earn as many points as you can. At times only one touch will earn you a point, at other times many touches will be required.

*Now, touch the circles and icons that appear to become more familiar with the procedure.

During the procedure, there will also be times when a touch is required simply to move the program along to the next trial.

During this experiment, you will notice that some trials will include more than one icon, and some trials will not. Your goal is to earn as many points as possible. This is a learning task. It is important that you **pay attention to the icons as they are presented**. This will help you to determine how to respond. A new scenario will begin when the screen goes black, a plus sign appears, and finally a circle appears. Touching this plus sign will not result in any points. By paying attention to the order of events, it is possible to earn the maximum number of points.

Your goal is to earn as many points as possible. Keep in mind that a scenario may require you to touch the icon several times before points are given. Pay close attention and **<u>please do not press at random</u>**. Incorrect responses will lengthen the time of the experiment, but no longer than the maximum 60 minutes.

Sometimes you will encounter new combinations of icons; you should still do your best to use what you have learned to continue earning points. Do your best to respond as quickly and accurately as possible. Now, go earn some points!

Script of instructions for Experiment 3. Read by the participant.

Experiment 3 Script

Pretraining

On your screen, you will see a circle. When you touch the circle, a picture of money may appear on the screen. This money allows you the opportunity to earn points. You want situations in which you can earn points—this event is meant to be reinforcing. When you do not receive money, you are not reinforced. Then, one or two squares may pop up. These squares act as labels for whether you receive money (yay) or whether you don't receive money (boo). You will want to pay attention to which touch to which square is correct, which will move you on to the next trial. By paying attention to the order of events, you can earn points. Your goal is to earn as many points as you can. At times only one touch will earn you a point, at other times many touches will be required.

*Now, touch the circles and icons that appear to become more familiar with the procedure.

During the procedure, there will also be times when a touch to the circle is required simply to move the program along to the next trial.

During this experiment, you will notice that some trials will include money, and some trials will not. Use these squares to label whether or not you receive money. By doing so, you can earn the maximum number of points. Your goal is to earn as many points as possible. This is a learning task. It is important that you **pay attention to the icons as they are presented**. This will help you to determine how to respond. A new scenario will begin when the screen goes black, a plus sign appears, and finally a circle appears. Touching this plus sign will not result in any points. By paying attention to the order of events, it is possible to earn the maximum number of points.

Your goal is to earn as many points as possible. Keep in mind that a scenario may require you to touch the icon several times before points are given. Pay close attention and **please do not press at random**. Incorrect responses will lengthen the time of the experiment, but no longer than the maximum 60 minutes.

Sometimes you will encounter new combinations of squares; you should still do your best to use what you have learned to continue earning points. Do your best to respond as quickly and accurately as possible. Now, go earn some points!

Participant Debrief. Answered upon completion of the experiment.

Debriefing

What kind of information did you use to determine the correct response? (e.g. order of events, features of the icon)

Did you notice that some circles (patterned black and white) were followed by certain events?

Did you notice that some trials required a response to one of two icons (blue vs. pink)? What information did you use to choose on or the other icon?

How confident were you in your responses?

READ

The experience of emotions involves a process in which we learn to label internal sensations caused by external events. For example, when you are given a piece of candy, an internal sensation is elicited which you have learned to label "happy". This study was interested in the use of visual labels—rather than verbal labels—to label emotions. An icon was always followed by reinforcement (points) or non-reinforcement (no points). These external events elicited internal sensations, which we wanted you to label with either the blue or pink shape. The purpose of this research was to gather more information on the ability to use visual icons to label specific internal and external events. Thank you for your participation. Please do not discuss the specifics (how much you were paid, the procedure, what stimuli to pay attention to, etc.) of this experiment with your friends. If you have any questions, or would like additional information please contact Dr. Kenneth J. Leising in the Department of Psychology. He can be reached by calling his office 817-257-6139 or by e-mail (k.j.leising@tcu.edu).