THE IMPACT OF STIMULUS "VALUE" IN INFANT NOVELTY PREFERENCE

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PREFACE

Much research indicates that by 5 months of age, infants prefer novel over familiar stimuli. The purpose of the present paper is to determine whether novelty preference in infants can be manipulated through stimulus association. Therefore, the role of stimulus "value" in infant novelty preference was investigated. Five-month-old infants were randomly assigned to two groups. In the experimental group, a classical conditioning analogue procedure was employed where a neutral tone was associated with a picture of mother's face (over 100 trials). In the control group, infants received 100 presentations of the tone alone. A posttest was administered to both groups to measure infants' preference between the tone presented during familiarization and a novel tone. Results indicated that in the experimental group, infants preferred the familiar over the novel tone, whereas, in the control group, infants preferred the novel over the familiar tone. Thus, it appears that the mother's value was conferred onto the tone. These results provide evidence that an associated value to a neutral stimulus can actually override novelty preference.

I would like to express my utmost appreciation to Dr. David Thomas for chairing the committee and for providing invaluable guidance throughout this project. I would also like to sincerely thank my committee members, Dr. Charles Abramson and Dr. Doug Hershey (Fearless Leader) for their valuable input and consistent support.

I would like to thank my FAMILY for their love and support, especially my sis, Maha Ghattas, for making me realize my potentials. This is for you MOM & DAD!

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CHAPTER I

INTRODUCTION

Defining Novelty Preference

The concept of novelty preference has been widely investigated in the field of infancy (Caron, Caron, Minichiello, Weiss, & Friedman, 1977; Rose, Gottfried, Carminar, & Bridger, 1982; Spence, 1996). It is employed by investigators mainly to assess recognition memory and the ability to discriminate among visual and auditory stimuli. In this work, most researchers define novelty as a stimulus that has not been previously presented or observed and thus is unfamiliar to the subject. Novelty is perceived as a very powerful concept in attracting one's attention due to the originality and uniqueness that it provides. However, such attention is not maintained for long because the effect of novelty, even though influential, is also transient. Therefore, novelty is usually alluded to in terms of " a time continuum along which an object which was once novel becomes familiar" (Saayman, Ames & Moffett 1964, p. 190). Thus with repeated exposure, a novel stimulus will eventually become familiar and the time spent fixating that stimulus will in turn decrease. Such decline of responding is called habituation (Peterzell, 1993). Fantz (1964) defined novelty preference as an unlearned visual interest in a complex stimulus which has not been habituated by experience. Taking into consideration the influence of "novelty", the purpose of the present study is to determine whether novelty preference in

infants can be manipulated through stimulus association.

Novelty Preference Literature

A great deal of literature illustrates the robustness of novelty preference in infancy. The general findings stemming from this area, whether dealing with visual or auditory paradigms, show that infants beyond 2 months of age exhibit a reliable preference for the novel stimuli, whereas infants younger than 2 months of age prefer familiar (Hunter & Ames, 1988). For example, Fantz (1964) presented photographs to infants from 1 to 6 months of age. One of the photographs (varied among the subjects) served as a constant pattern and was presented for 10 successive 1-minute trials. In each trial, the photograph was paired with one of the remaining 10 photographs in random order. As trials progressed, infants over 2 months demonstrated a decrease in looking fixation to the constant (familiar) photograph and an increase in fixation to the novel. The percentage of looking fixation for infants younger than 2 months remained consistent over trials for the familiar pattern. Similarly, Weizmann, Cohen and Pratt (1971), familiarized 4-week-old infants to one of two mobiles for a period of 4 weeks. Mothers were instructed to familiarize the infant with the mobile for 30 minutes a day, during a time when the infant was alert and content. At 6 weeks infants fixated longer at the familiar mobile, whereas at 8 weeks the fixation time was significantly longer for the novel mobile. In relation to auditory stimuli, Colombo and Bundy (1983) found a novelty preference in 4-month-olds but a familiarity preference in 2-month-olds for tonal patterns. These examples in turn show the diversity of paradigms resulting in novelty preference with infants over 2-months of age. However, such age distinction in relation to novel versus familiar preference is not

qualitatively based. In other words, it does not appear to be related to changes in memory processes, but rather it seems to depend on amount of familiarization (Rose et al., 1982; Richards, 1997). Nonetheless, the established trend in the field of infancy indicates a strong novelty preference in infants beyond two months of age.

The "Value" Factor

During the past 30 years, numerous infant studies using various procedures and various stimuli have demonstrated the initial increase in attention due to the novelty value and the subsequent decrease in attention due to habituation. However, not until recently has the " value " factor been incorporated into the novelty-preference (paired-comparison) paradigm. We define value with reference to the following properties: 1) the affective property of the stimulus , 2) the reinforcing properties of the stimulus, 3) the functional value of the stimulus and 4) the meaningfulness of the stimulus. Investigators have been implementing the value factor in attempts to influence and manipulate infants' visual fixation. For example, in a recent study, the "affective value" of a stimulus has been investigated using 7-month-old infants (Nachman, Stern & Best, 1986). The infants sat on their mother's lap facing a small theater designed with left and right windows; hand puppets (a rabbit and a frog) were presented in those windows. The pretest consisted of two 15-second trials. On the first trial, the rabbit puppet appeared in the left window and on the second trial, the rabbit puppet appeared in the right window. Results indicated that during the pretest, infants looked equally at both puppets. Shortly after the pretest, one of two familiarization procedures was used for each infant. In the first procedure (experimental group), a rousing method which consisted of disappearance and

reappearance of one of the puppets behind the screen was implemented to elicit a smile. In the second procedure (control group), a neutral method was implemented where one puppet would sway horizontally across the window span and was always in sight. Both the rabbit and the frog puppets were randomly assigned to these two familiarization conditions. After the familiarization period, a posttest was conducted where the infants were shown the two puppets in the theater exactly as in the pretest. Results indicated that infants assigned to the experimental group and who responded with positive affect towards the familiarization puppet (e.g.,the rabbit) focused their attention more on that puppet (the rabbit), whereas infants who were assigned to the control group and responded neutrally to the familiarization puppet (again take the rabbit as an example) focused their attention more on the less familiar puppet, in this example the frog more than the rabbit. According to the outcome of this study, the affective value of a stimulus for the infant has to be accounted for when investigating infant's visual preference.

As mentioned earlier, the value factor is comprised of various stimulus properties. The impact of such properties on infants' orienting responses was recently investigated where the value of the stimulus was manipulated into three different functions, eliciting, signaling and reinforcing (Malcuit, Bastien & Pomerleau, 1996). The focus of the study was " to isolate the several functional values an attention-getting stimulus may possess or acquire and to determine the differential effect of these functional values on the stimulus effectiveness to elicit orienting responses in infants" (Malcuit et al.,p. 273). The authors posited that a neutral stimulus will trigger an infant's attention (visual exploration), however, such attention might be triggered in a different way, or for a longer period of time if that stimulus had some relative value that is in turn significant to the infant. This

study consisted of a familiarization phase of twelve trials, a test phase of two trials and a dishabituation phase of two trials. In the "eliciting" condition, a checkerboard pattern was presented for two seconds with an inter-stimulus interval of 10 seconds. In the "eliciting-signaling" condition, a checkerboard pattern was presented for two seconds and at the same time, a cartoon film was projected 45 degrees from the location of the checkerboard pattern. In the "eliciting-signaling-reinforcing" condition, a checkerboard was presented for as long as the infant looked in its direction. Results indicated that, unlike the other two functions, there was a continued orientation to the checkerboard pattern that signalled the onset of the cartoon film. This continued orientation was interpreted to mean that the infants learned the association between the presentation of that stimulus (the checkerboard) and an attractive visual event (the cartoon film). Consequently, that stimulus in turn gained a value which made it more meaningful to the infant.

Discrepancy Between the Physiological and the Behavioral Findings

A recent study in our laboratory produced results which seem to contradict the established findings of novelty preference in the infancy field. In this study, 5-months-old infants were familiarized with a simple auditory tone (over 100 presentations) on the first day. On the second day, they received 50 presentations of the familiar tone (that they heard on the first day) and 50 presentations of the novel tone. Scalp recorded event-related potentials (ERPs) recorded to that familiar stimulus 24 hours later were both larger in amplitude and less temporally variable in comparison to the ERPs to a novel stimulus (Thomas & Lykins, 1995). Several other studies have found a late positive ERP

component to be larger to novel vs. familiar stimuli (Hofmann & Salapatek; 1981; Hofmann, Salapatek, & Kuskowski, 1981; Nelson & Salapatek, 1986). According to Vaughan and Kurtzberg (1992), the magnitude of the ERP components reflects the summed electrical activity of neuronal networks in response to a stimulus. Therefore, based on such information, the generated ERP components in the Thomas and Lykins study indicate more neuronal activity taking place to the familiar, and not to the novel tone. Again, assuming that higher amplitude means added attention or processing (Hansen & Hillyard,1980), the results of Thomas and Lykins seem to contradict the existing findings on novelty preference. However, a second study using behavioral measures with the same stimuli and a similar procedure as in the ERP study found the typical novelty preference (Thomas, et al., 1997); infants looked significantly more toward the speaker that was emitting a novel tone versus the speaker that was emitting a familiar tone. These results indicate a behavioral preference for the novel tone under conditions very similar to those in which Thomas and Lykins (1995) obtained larger ERP amplitudes to the familiar stimuli.

A Plausible Interpretation of the Existing Discrepancy Between the Physiological and the Behavioral Findings

Even though the two above studies (ERP and the behavior) implemented similar procedures and the same stimuli, there was one variable factor among the two designs. Infants were feeding during the familiarization procedure in the ERP study but not in the behavioral study. Such a procedure was used in order to keep the infants calm and to prevent any gross motor movements (kicking, arm movements, etc) which tend to be

picked up by the scalp monitors and consequently hinder any accurate recordings. As a result of such a variation in the implemented procedures, the following question was raised: Was the feeding procedure causing a discrepancy between the results? In other words, did an association take place between the tone presentation and the feeding that might have influenced the results? Since the feeding experience reflects one of the properties of the value factor that was mentioned above, in this case, the reinforcing property, the question becomes: Was the feeding reinforcing the amplitude of the ERP component?

Mother's Face as the Value Factor

Taking into consideration the conflicting data that have been generated by the above behavioral and ERP studies, the present study involved a behavioral paradigm in which the significance of the value theory was investigated. A picture of mother's face was employed as the value factor in comparison to the food factor used in the ERP study. It was manipulated in order to determine whether the value hypothesis can be generalized to other factors in the environment, and not simply to nourishment. Furthermore, it was perceived as an easier factor to manipulate (in comparison to a live face or to feeding) during the administration of contingent stimulus presentations. In relation to implementing a photographic presentation of mother's face in this paradigm, existing research indicates that by 3 months of age, infants are able to recognize and discriminate among live as well as photographic faces (Barrera, 1977, as cited in Barrera & Maurer, 1981). For example, by 5 months, " infants who have been habituated to a live face showed no change in fixation time when presented with an immediately following

photographic slide of that same face, while they showed an increase in fixation time (dishabituation) to a photographic slide of a novel face" (Dirks & Gibson, 1977, p. 124).

Reinforcing Properties of Faces

There is a great deal of merit behind using mother's face as an unconditioned stimulus in the present study. For example, Bowlby (1960) declared that the initial attachment by the infant to his mother is a result of species-specific behavior patterns. These instinctual-response systems guide the infant to bond with other humans, and later to a particular mother-figure (Bowlby, 1960, as cited in Goslin, 1969). Such significant, individualized attachment occurs between 3 and 6 months of age as a result of repeated interactions.

In addition to its attachment value, the human face contains intriguing and appealing characteristics that are extremely influential in capturing infants' attention. Some theorists advocate that infants may enter the world with a predisposition to respond to faces (Miller, 1984, as cited in Kaplan, 1992) by simply focusing on the distinctive physical characteristics. Others believe that it is not so much the intrinsic physical features of the face that capture the infant's attention. Rather, such arousing properties are a product of repeated pairings of the face with primary reinforcers (Gewirtz, 1969, as cited in Kaplan et al., 1992). Regardless of the source of the "value" of faces, by 5 months, infants are thought to be able to recognize faces and in turn their behavior is influenced by established associated experiences.

There is an ample amount of research that illustrates that faces in general are arousing stimuli that in turn attract infant's visual attention (Oster, 1981, as cited in Kaplan et al., 1992; Maurer, 1985). Kaplan, Fox and Huckeby (1992) investigated the

reinforcing properties of faces by pairing a female face (of various expressions; smiling, surprised, and neutral) with a tone and subsequently tested that tone's ability to increase visual fixation on a checkerboard pattern. Results indicated that the tone that was associated with the smiling and surprised expressions (but not the neutral expression) influenced visual fixation significantly more to the checkerboard than when the checkerboard was presented alone. Therefore, Kaplan demonstrated associative learning in infants and how such learned association influenced visual attention.

Purpose and Significance of the Study

As mentioned above, it was speculated that the higher ERP amplitude for the familiar tone in comparison to the novel tone (Thomas & Lykins, 1995) was due to the increased "value" that stimulus obtained from being associated with food. The present study examined whether a neutral stimulus paired with mother's face can indeed influence infants' preference over the reliably established novelty findings. Consequently, this study employed a picture of mother's face in a classical conditioning analogue procedure[1] in an attempt to manipulate infants' preference in relation to familiar versus novel stimulus. This entailed implementing a familiarization procedure where a neutral tone was contingently associated with mother's face over 50 trials. A second group received 50 tone presentations with no other stimuli. Immediately following the familiarization process, infants' preference was tested between the familiarized tone and a novel tone. It was hypothesized that through the applied classical conditioning analogue procedure,

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[1]The emphasis of this study was to demonstrate the ability to influence infants' familiarity/novelty preference through stimulus association and not to demonstrate associative learning. Consequently, the required control groups were not implemented, hence the term analogue.

mother's face will confer value onto the associated tone and such associated value in turn will override novelty preference.

Classical and Instrumental Conditioning

Previous research indicates that classical and instrumental conditioning is readily achievable in infants (Brackbill & Koltsova, 1967) . Most relevant to the conducted research is a study by Silverstein (1972) who used a conditioning paradigm with a tone as the discriminative stimulus and food as the primary reinforcer. In this study, 10-month-old infants were taught to spatially discriminate between geometric figures. In the conditioning phase, upon touching the appropriate target, infants received a presentation of a tone (T+) followed by Froot Loops cereal as reinforcement. The pairing of T+ and the cereal was presented on a fixed interval schedule during which they received the presentation of another tone (T-) with no reinforcement. In the testing phase, touching one of the two new targets produced T+ and touching the other target produced T-. Results indicated that infants responded significantly more to the T+ than the T-, thus demonstrating the secondary reinforcement effect. A secondary reinforcer is " a stimulus that enhances the level of a preceding response (beyond that of an appropriate control stimulus) because of its prior contingent presentation with a primary reinforcer" (Silverstein, 1974, p. 323). For the current experiment, an analogous procedure was employed to associate a tone with mother's face (primary reinforcer) and in turn endow the tone with similar influential properties as those associated with the mother's face (making the tone a secondary reinforcer).

Another study by Lu (1967) demonstrated the early conditioning of perceptual

preference. In this study, Fantz's (1964) perceptual measure was applied as an assessment of classical conditioning utilizing a red light as the conditioned stimulus and food as the unconditioned stimulus. Initially, Lu found that the color red was not highly preferred by 2-month-old infants (4th out of 8 prints). He investigated whether the infant's initial preference for a stimulus can be made more significant in order to change the preference hierarchy for that particular stimulus. During the conditioning trials, the infant was fed by the mother who was wearing a red blouse, and who was instructed that during every feeding period to use a red light bulb on the lamp that was placed beside the baby. Thus, with each onset of the red light (15 sec), food was introduced and then the light was off for 10 seconds. Results indicated that during the posttest, out of eight photographic prints, infants preferred the color red second in comparison to fourth in the pretest. This suggests that the conditioning paradigm used in this study was successful in endowing the color red a positive value that in turn influenced the infant's preference.

Hypothesis of the Study

From the above mentioned studies, it has been demonstrated that significant results have been generated during the implementation of both visual and auditory modalities using classical or instrumental conditioning paradigms. In relation to this study, it was hypothesized that over trials, the association between the tone and mother's face will be established, and therefore, the value that mother's face entails will in turn endow the neutral tone with enough value to actually override novelty preference.

CHAPTER II

Method

Participants. Thirty infants participated in this study. The final sample consisted of 24 infants who were between 150 $\pm$ 14 days of age. The loss of subjects was due to the following conditions: one infant had Down syndrome, three infants cried excessively, one infant did not show up for the appointment, and one infant was lost due to experimenter's error. The infants were mostly from middle class families and had no history of visual or auditory impairments, and only full-term infants were accepted to participate in the study. Subjects were recruited from birth announcements published in the local newspaper. At the end of the testing session, the parents were monetarily compensated for their time and participation.

Apparatus. The baby sat in an infant seat which was mounted on the apparatus table 1 meter[2] away from a wooden panel (see Figure 1). The panel (4 feet X 6 feet) was designed with a left, a right and a center window located at the same height as the infant's eye level. In the left and the right windows, a toy clown wrapped in Christmas lights was

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[2] Infant's visual acuity at 5 months is 20/200 in relation to adults acuity which is 20/20. This indicates that at 20 feet, the image seen by the adult needs to be 10X larger in order to be seen by the infant (Hillier, 1994). However, bringing the image closer from 20 feet to 3.33 feet (1 meter), the image needs to be 1.6X larger than the image seen by the adult: (20ft / 3.33ft =6.006, then 10X/6.006 = 1.6X larger at 1 meter).

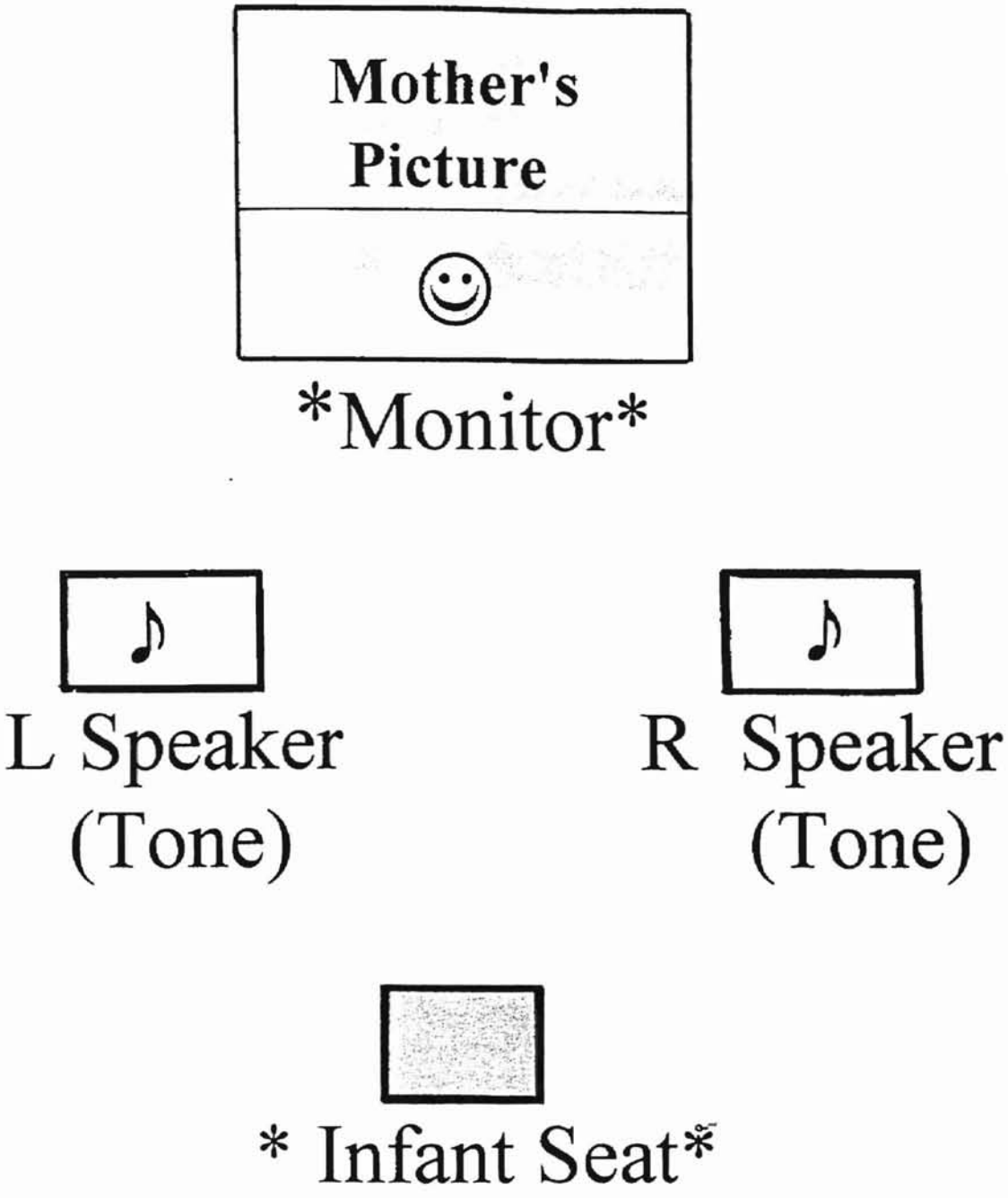

Figure 1. A diagram of the apparatus that was used in both the experimental and the control procedures.

placed behind the windows' sliding doors, whereas the screen of a 15 inch computer monitor was fully displayed in the center window. About 6 inches above the computer monitor, a camera lens was displayed through a circular opening in the panel and about 6 inches below the computer monitor a light bulb was attached to the front of the panel fully visible to the infant. Two small speakers were located on the apparatus table below the side windows and 45 degrees diagonally from the location of the infant's seat. Five feet away from the apparatus table (behind the infant), a work station was organized from which the experiment was controlled. The work station included a computer, a VCR and a small television where the infant's looking behavior was monitored and recorded.

Stimuli. Both visual and auditory stimuli were employed. The visual stimulus consisted of a picture of mother's smiling face (taken by a digital camera) and was presented via computer monitor (the picture was displayed from the neck up, about 8" in height which is approximately the size of a live face). The auditory stimuli consisted of two simple tones (400 or 700 Hz, 100ms, 4s inter-stimulus interval) that were emitted from two small speakers located on either side of the computer monitor. For half of the infants in each of the two groups, the 400 Hz tone served as the familiarized stimulus and the 700 Hz tone served as the novel stimulus. The other half of each group received the opposite, the 700 Hz tone for the familiarized stimulus, and the 400 Hz for the novel stimulus.

Procedure. Parents were asked to bring their infants to the laboratory at a time when their infants would be most alert. Upon arrival, the mother was taken into a small room where she was familiarized with the experiment and was reassured that she could

terminate the experiment at any time. After the consent form was filled out, the mother and the baby were brought to another room that was located down the hall from the apparatus room where a camera was set up to take a picture of mother's face. Not all mothers had their picture taken due to the differential treatment that took place between the experimental and the control group. Infants in the experimental group received the presentation of both a picture of mother's face and a tone, whereas infants in the control group received successive presentations of the tone only (picture of mother's face was not required). However, in order to maintain the same procedure in both groups, all mothers retired to the camera room for 10 minutes before the initiation of the experiment.

Immediately after the picture session, the mother and the infant were taken to the apparatus room to initiate the experiment. The infant was seated in a car seat that was mounted on the apparatus table, while the mother was present in the same room but behind and out of the infant's sight. Throughout the study, a computer monitor on which the visual presentation (picture of mother's face) was administered was positioned 1meter away from the infant's car seat . The auditory stimuli (tones) were emitted from two small speakers, one speaker positioned on either side of the computer monitor.

This was a one-day study where a random schedule for group assignment, familiarization tone and the tone used during the posttest was originally established before piloting was initiated. For example, each subject was randomly assigned to either the experimental or the control group, and the different tone frequencies (400 or 700) were randomly assigned to the familiarization and the posttest trials. In the experimental group, a classical conditioning analogue paradigm was employed where a neutral tone (100 ms duration) was presented immediately prior to the onset of mother's face (1.5 s

duration) on the computer monitor, with an interstimulus interval of 0 sec and an intertrial interval of 3.5 secs. A total of 50 tone-face presentations were administered. In the control group, infants received 50 successive presentations of the tone (100 ms duration) alone, with 5 secs interval between each tone (see Figure 2).

At the end of the familiarization procedure, a posttest of two 1-minute trials was given to evaluate infants' behavioral preference between the familiarized tone presented and a novel tone. To capture the infant's attention, a light bulb was fastened underneath the camera lens and was flashed periodically for the infant to visually fixate ahead before the presentation of the tones. The tones were presented via two speakers; the familiar tone was presented once per second from a speaker located 45 degrees lateral to the midline, and the novel tone was presented at the same rate but offset by 0.5 seconds from a speaker 45 degrees in the opposite direction. Thus, such tone presentations were counterbalanced where on the first trial, the familiar tone came from the one speaker, and on the last trial, the familiar tone came from the other speaker in an AB or BA order. Throughout the posttest, each speaker was ornamented with a clown wrapped in Christmas lights in order to attract the infant's attention in the direction of the speakers. The camera recorded the infant's visual fixation on videotape which was later on measured by two teams of blind scorers.

Each team consisted of two assistants scoring the tapes of the recorded sessions by timing infants' visual fixation (in secs) towards the left and the right speakers (using a stopwatch). For example, one member of the team focused on the left half of the television screen thus timing infant's looking time towards the right speaker (on both trials), and the other member focused on the right half of the television screen thus

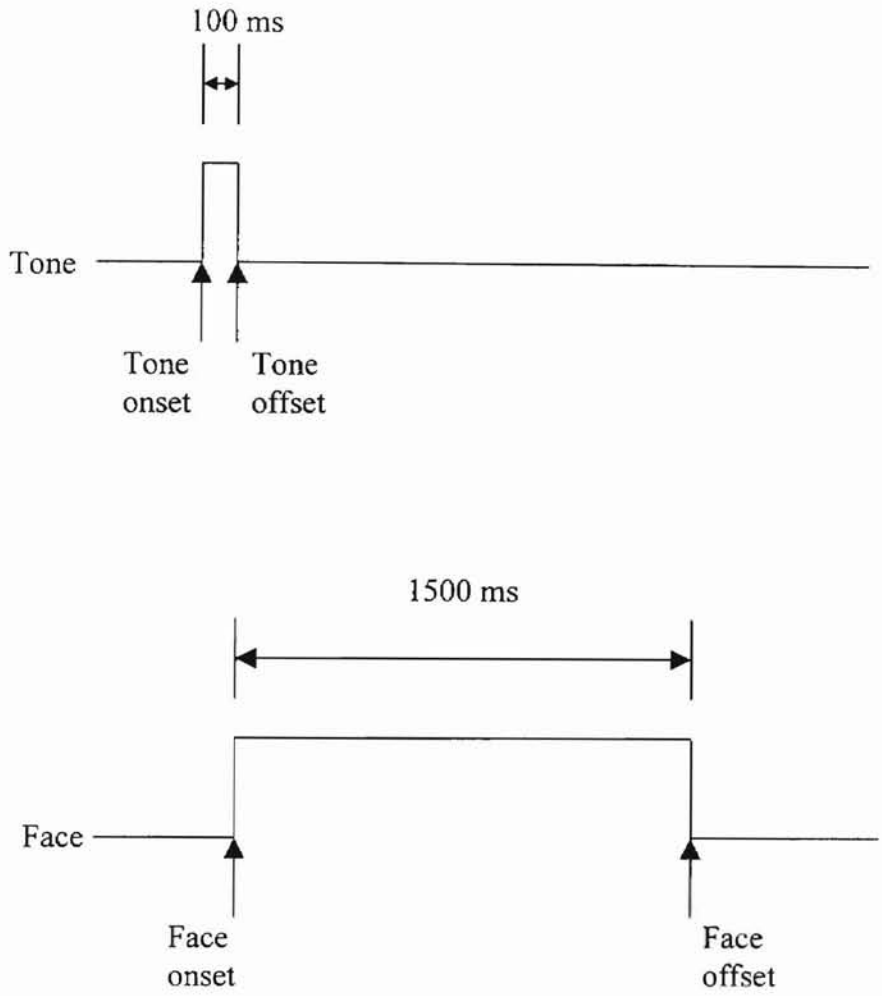

Figure 2. Schematic diagram of stimulus presentation during familiarization. For both groups, the inter-trial interval (tone onset to tone onset) was 5.1 s (5100 ms). For the experimental group, face offset to tone onset was 3.5 s (3500 ms).

measuring infant's looking time towards the left speaker (on both trials). Even though the experiment was videotaped, the tones that were administered during the familiarization and testing trials were not recorded. In order to direct the scorers of when to start and when to stop measuring infant's looking time towards the speakers, a light bulb was placed behind the infant; when the bulb was lit, that indicated the onset of a trial session and when the bulb was off, that indicated the end of the session. Each team collected four data points per infant; how much the infant looked towards the familiar tone versus how much the infant looked towards the novel tone during the first and second trials. The interrater reliability between the two teams was established at r =.97.

Results

It was hypothesized that in the conditioning analogue group, the association between mother's picture and a neutral tone should endow the tone with some value, and consequently, influence infants' fixation more towards that associated tone over a novel one. The influence of such a value factor was assessed by a 2 (familiarization tone) X 2 (group) X 2 (posttest trials) analysis of variance carried out on the percent time fixating the novel stimulus. This dependent measure is referred to as the "novelty quotient" and is calculated as: (time fixating novel) /(time fixating novel + time fixating familiar) (Richards, 1997). Results indicated a significant main effect for group F (1,20) = 5.59, p=.028 (see Figure3) (Table 1). Since there are only two levels of the group factor, the generated means for the experimental and the control groups were directly interpreted; in comparison to the experimental group, infants in the control group had a higher percentage of looking time towards the novel tone, a mean of 45% vs. 55%,

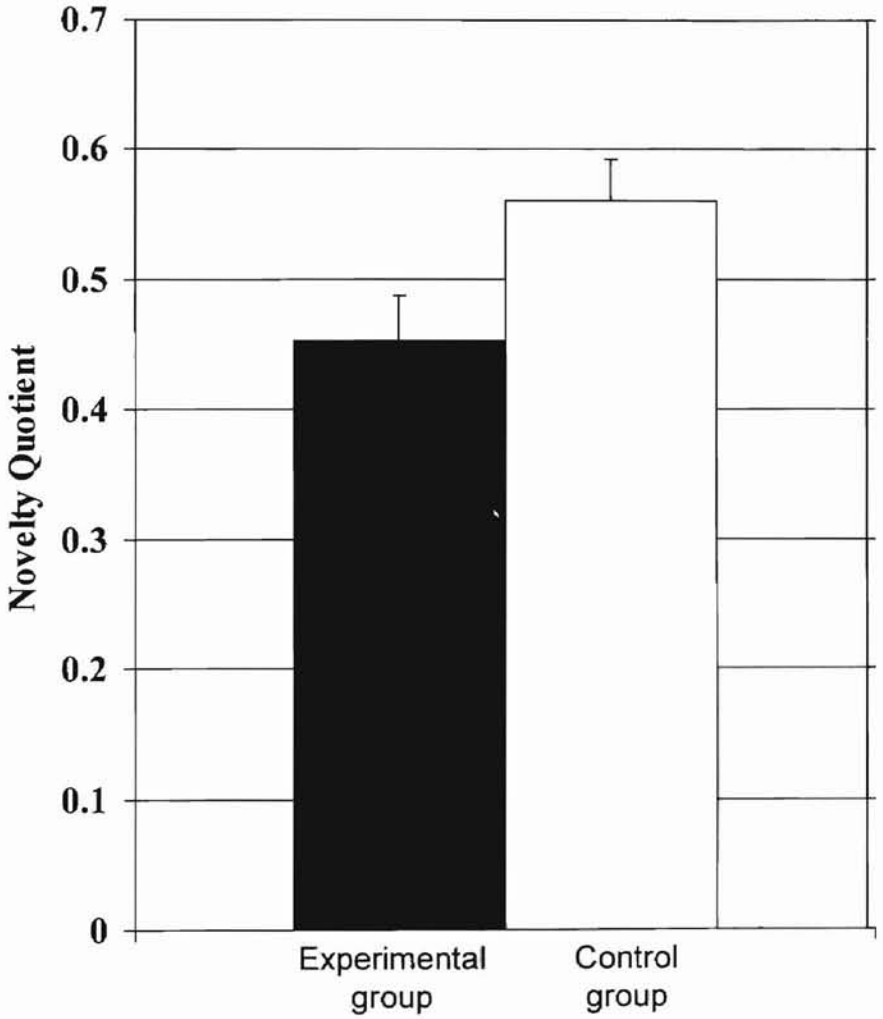

Figure 3. Novelty quotients for each group. Error bars represent one standard error of the mean.

Table 1
Analysis of Variance Source Table

Novelty Quotient

Source	df	SS	MS	F	p
Between Subjects					
Within+Residual	20	.39	.02		
Famtone	1	.00	.00	.05	.829
Group	1	.11	.11	5.59	**.028**
Famtone By Group	1	.04	.04	2.16	.157
Within Subjects					
Within+Residual	20	1.87	.09		
Trials	1	.02	.02	.25	.624
Famtone By Trials	1	02	.02	.25	.626
Group By Trials	1	.05	.05	.58	.456
Famtone By Group By Trials	1	.16	.16	1.70	.207

respectively. There were no other significant main effects or interactions. Further analysis was conducted to evaluate each novelty quotient against 50% in order to determine whether the generated values were significantly different than values generated by chance. A one-tailed t-test indicated that the percentage of looking time for the novel in the control group was significantly different from 50%, $t(11)= 1.85$, $p=.046$, (see Table 2) whereas the percentage of looking time for the novel in the experimental group was not significant, $t(11)= -1.40$, $p = .095$ (see Table 3). These results indicate that a strong novelty preference was established in the control group and not in the experimental group.

The data were further assessed by a 2 (group) X 2 (familiarization tone) X (2 test trials) analysis of variance carried out on the total looking time (in sec) for the experimental and control group. Although results indicated no significant difference in overall looking time between these two groups $F(1,20)= .38$, $p= .544$, the difference that did exist reflected more looking time for the infants in the experimental group than the control group (see figure 4)(see Table 4).

An analysis of variance of 2(group) X 2(familiarization tone) X 2 (test trials) was carried out on the mean fixation time for the familiar tone. Results indicated a significant main effect for group $F(1,20)=4.40$, $p= .049$ (see figure 5) (see Table 5), revealing that infants in the experimental group versus control group looked significantly more towards the familiar than the novel tone, a mean of 48.1 secs versus 34.45 secs, respectively. There were no other significant main effects or interactions. An analysis of variance of 2 (group) X 2 (familiarization tone) X 2 (test trials) was also carried out on mean fixation time for the novel tone. Even though a strong novelty preference was established in the control group (as indicated by above analysis), results indicated no significant main effects

Table 2
One-Tailed t-test

Percent-Novel Against 50%
(Control Group)

Variable	Number of Cases	Mean	SD	SE of Mean
Percent-Novel (Control)	12	.5599	.112	.032

Test Value =.50

Mean Difference	95% CI Lower	Upper	t-value	df	2-Tail Sig
.06	-.011	.131	1.85	11	**.092 / 2= .046**

Table 3
One-Tailed t-test

Percent-Novel Against 50%
(Experimental Group)

Variable	Number of Cases	Mean	SD	SE of Mean
Percent-Novel (Experimental)	12	.4528	.1117	.034

Test Value =.50

Mean Difference	95% CI Lower	Upper	t-value	df	2-Tail Sig
-.05	-.121	.027	-1.40	11	.190 / 2=.095

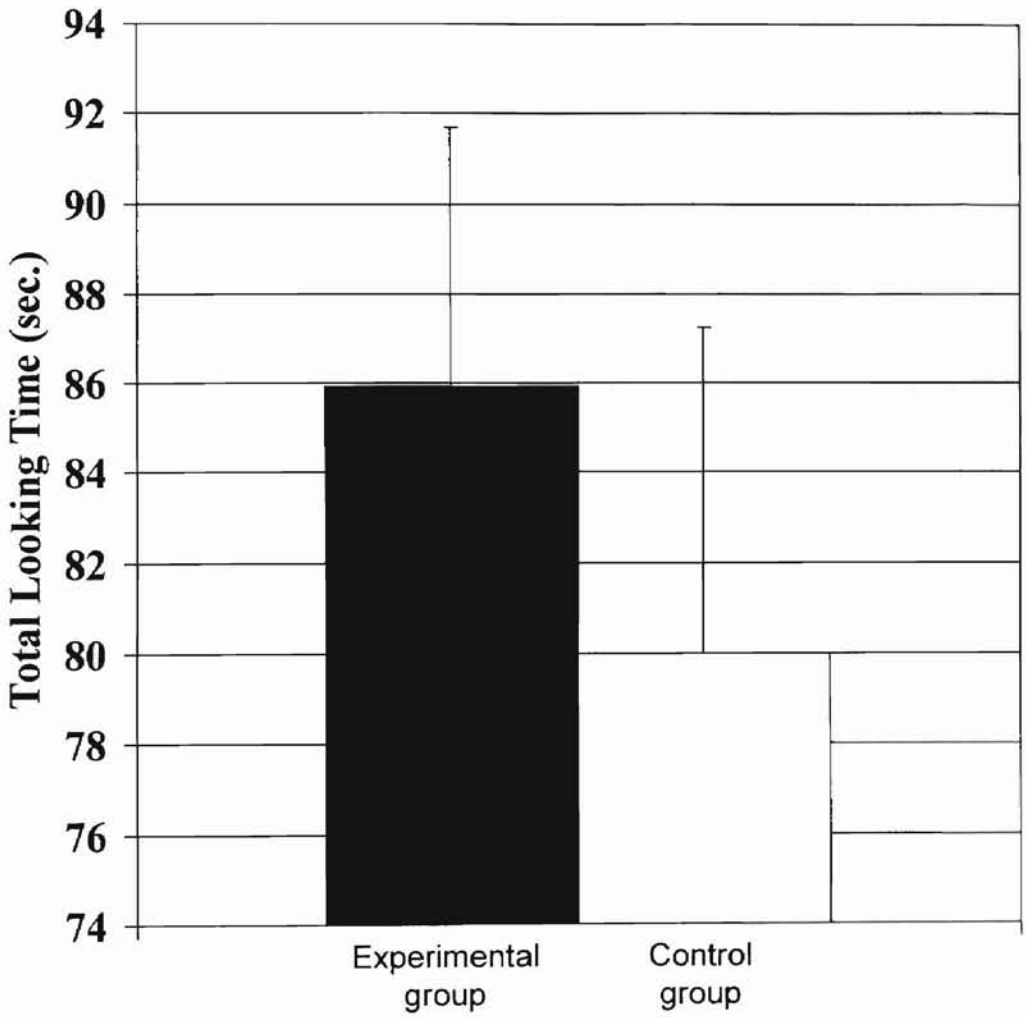

Figure 4. Total time spent looking at both of the speakers by each group. Error bars represent one standard error of the mean.

Table 4
One-Way Analysis of Variance

Grand Total By Group

Source	df	SS	MS	F	p
Between Groups	1	211.7610	211.7610	.4124	.5274
Within Groups	22	11295.4979	513.4317		
Total	23	11507.2589			

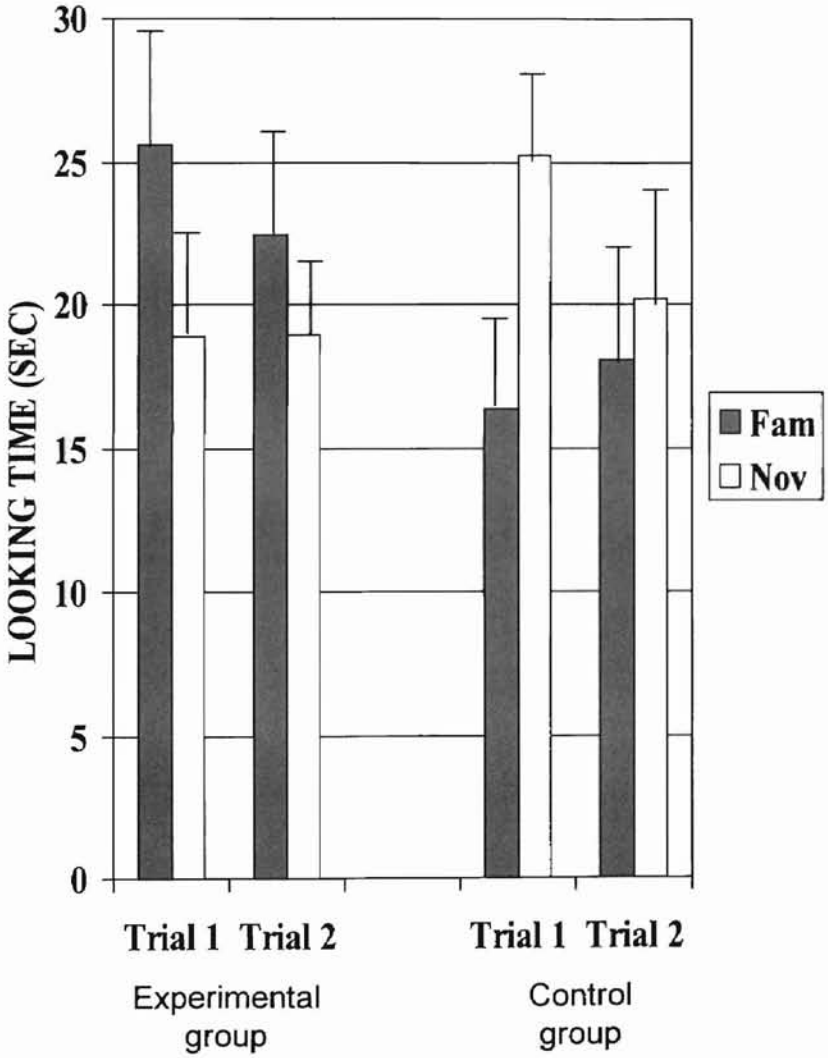

Figure 5. Looking time as a function of group, trial and condition. Error bars represent one standard error of the mean.

Table 5
Analysis of Variance

Group X Familiarization Tone X Trials
(Familiar Tone)

Source	df	SS	MS	F	p
Within+ Residual	20	2541.49	127.07		
Famtone	1	13.26	13.26	.10	.750
Group	1	559.31	559.31	4.40	**.049**
Famtone By Group	1	75.88	75.88	.60	.449

Table 6
Analysis of Variance

Group X Familiarization Tone X Trials
(Novel Tone)

Source	df	SS	MS	F	p
Within+ Residual	20	2165.22	108.26		
Famtone	1	12.75	12.75	.12	.735
Group	1	176.49	176.49	1.63	.216
Famtone By Group	1	108.96	108.96	1.01	.328

between the two groups $\underline{F}$ (1,20)=1.63, $\underline{p}$=.216 (see figure 5). Even though the generated results revealed no main effect or interactions for the novel tone, figure 5 illustrates that infants looked more towards the familiar tone in the experimental group (on both trials) and more towards the novel tone in the control group (on both trials). Furthermore, it appears that infants' looking time in the direction of the preferred tones declined from trial one to trial two reflecting habituation due to repeated presentations.

Although the presence of the significant F for the group main effect (novelty quotient) provides assurance that a statistical difference exists between the experimental and the control group, omega squared was calculated to give us an indication of the effect size or the magnitude for such effect, $\hat{\omega}^2$=.218 in comparison to Cohen's (1977) cut-off for a large effect size of $\hat{\omega}^2$= .15 or greater. Due to the limited number of participants used in this study, power was indicated at .612. However, regardless of the small sample size and lack of power which exist in this design, the effect of the manipulated variable was strong enough to be detected.

CHAPTER III

GENERAL DISCUSSION AND ALTERNATIVE HYPOTHESES

General Discussion

As a result of the discrepancy between the ERP and behavioral data from our laboratory, the main objective of this experiment was to investigate possible factors that might have contributed to this discrepancy. Although any number of variables can indeed influence any experimental investigation, however, with sufficient guidance from the established infant literature in relation to our specific designs, such an issue was developed into a more general question regarding what we call the "value" of the stimulus. This investigation implemented the same stimuli and a similar procedure to that used in the ERP and the behavioral studies. The current results appear to provide some guidance in explaining the disparate findings that were generated from the two above studies. In the experimental group, 5-month-old-infants looked significantly more towards the familiar stimulus after it was paired with the mother's face relative to the control group that preferred the novel tone. This finding resembles the data generated from our laboratory in relation to the ERP study (Thomas & Lykins, 1995), where a larger amplitude was found for the familiar than the novel. Furthermore, the paradigm that was implemented in the ERP study had something in common with the paradigm implemented in this study, a value factor (although, the value factor (feeding) was uncontrolled in the

ERP study). In the control group, this value factor was absent and consequently infants looked significantly more towards the novel than the familiar, thus replicating the widespread novelty preference that was also found in the behavioral study recently conducted by Thomas et al. (1997).

As a result of the implemented manipulation of the value factor (in this case mother's face), results indicate that the presence of mother's face appeared to have influenced differential responding from the infants. It appears that mother's value was conferred onto the associated tone and that tone with its associated value influenced infant's preferential looking and consequently overrode the novelty value. In relation to the ERP study, this experiment provides support for the hypothesized association that might have taken place between the food and the tone presentations, and consequently influencing the larger amplitude for the familiar and not the novel tone due to the reinforcing value of the food. Furthermore, in relation to the control group, it appears that the combination of stimulus habituation over familiarization trials (a result of repeated presentations) and lack of value association between the involved factors (no face followed a tone), led infants to focus their attention to the novel versus familiar stimulus. Thus, it appears that by increasing the significance of the stimulus, by making it more valuable to the infant through stimulus association, we were able to manipulate infants' information processing by means of captivating their prolonged attention to the familiar stimuli even in the presence of a very powerful tendency to respond to novel stimulation.

The results of this study and the concept of value can also be understood in terms of secondary reinforcement. Silverstein and Lipsitt (1974) conducted a study that

investigated the role of instrumental responding and contiguity of stimuli in the development of infant secondary reinforcement. Results indicated that "a tone paired only 20 times with food reinforcement can acquire the capacity to produce a subsequent spatial preference with infants if that tone's presentation is both in close contiguity with food delivery and contingent on the infant's making an instrumental response" (Silverstein & Lipsitt, 1974, p. 329). As this quote indicates, Silverstein and Lipsitt emphasized that, not only are stimulus contiguity and reinforcement important in an association paradigm (between the tone and the food), but also that the infant is required to make an instrumental response in order for the tone to acquire the capacity to influence infants' preference. In relation to the familiarization trials in the present study, almost all infants assigned to the experimental group looked straight ahead at the computer monitor. One interpretation might be that the infants were perhaps anticipating the onset of mother's face. Thus, it appears that such instrumental behavior of looking at the monitor was reinforced by the appearance of mother's face. Consequently, during the posttest trials, the familiar tone served as a secondary reinforcer for looking in the direction of its source.

Alternative Hypotheses

Careful assessment of the results was conducted in order to determine what contributed to the significant difference between groups. From an experimental design perspective, since mother's face was the only variable factor between the two groups, it was assumed that the differential responding was a product of this manipulated variable. However, since a true classical conditioning paradigm (not measuring a CR), and appropriate control groups (US alone, unpaired presentation or backward conditioning)

were not implemented, it cannot be determined with certainty that learning took place (Abramson, 1994). Furthermore, stimulus association may not have been established as a result of the contingent presentation; thus, mother's value may not have been conferred onto the neutral tone.

Two possible alternative explanations of the results focus on overstimulation and lack of adequate familiarization. Overstimulation occurs when the infant is overwhelmed with the presentation of a stimulus and therefore avoids anything that is more stimulating (e.g., higher in intensity or more complex) than that stimulus. Furthermore, the infant seeks to lower such overstimulation by avoiding anything novel, and sometimes might even look away from the repeated stimulus to further lower such stimulation. Gardner, Lewkowicz, Rose & Karmel (1986) conducted a study to investigate the overstimulation concept by manipulating the stimulation effects on visual preference. Results indicated that newborns tended to look at less stimulating events when overall stimulation level was increased. This demonstrates that for newborns at least, attention is very limited and if overstimulated, infants can shift to a lesser arousing stimulus, or it can even shut down.

In the present study, infants in the experimental group received input from both the visual and the auditory modality compared to infants in the control group who received only auditory stimulus. Consequently, it is possible that these infants were inundated with such stimulation that during the posttest they could not possibly process another novel stimulus, thus they ended up focusing on the familiar stimulus to avoid more stimulation. If the overstimulation hypothesis is what contributed to the differential effects between the experimental and control group, then the infants in the experimental group would have, on average, looked less than infants in the control group due to the extra stimulation.

However, the difference in total amount of looking time in both the experimental versus control group did not reach statistical significance, indicating lack of support for the overstimulation hypothesis. Furthermore, if overstimulation was the case, then one would also predict that the infant would look away from that repeated stimulus to further lessen that stimulation, thus leading to a lesser amount of fixation between trial one and trial two in comparison to the infants in the control group. However, results indicated that there was no significant difference across trials between the experimental and the control group.

In relation to the adequate familiarization hypothesis, Rose et al. (1982) declared that infants' preference for the novel versus familiar stimulus depends on the amount of familiarization, which in turn is a function of the infant's speed of processing. In relevance to this study, infants in the experimental group received contingent presentations of the tone and mother's face, where the tone was emitted from the speakers prior to the onset of mother's face on the screen. It may be that 100ms duration of tone presentation was not sufficient enough for the 5-months-old infant to process the tone completely before it was interrupted by the presentation of the mother's face on the monitor. Therefore, the habituation process to the tone may have been interrupted by the presentation of mother's face and thus only partial processing of the tone was established (Hunter Ross & Ames., 1982). Consequently, during the posttest, the infant focused on the familiar tone in order to complete such processing.

Future Research

The adequate familiarization hypothesis can not be fully tested without further

research. It appears that the current results support the value hypothesis, however as mentioned above, such support can also apply to other alternatives. Future research in our lab will consist of a behavioral study where the overstimulation and the amount of familiarization hypothesis will be investigated. In this proposed study, three groups will be implemented, each receiving a different treatment. In the first group, mother's face and a tone will be contingently presented over trials (the same paradigm will be used as was implemented in this study). In the second group, mother's picture and a tone will be noncontingently presented over trials. And finally, a control group will be implemented where the infants will receive tone only presentations over trials. The noncontingent group will be added in order to test for overstimulation. If overstimulation is what is contributing to the familiarity preference in this study, then we should receive the same results in both groups (the contingent and noncontingent groups). In addition to the proposed noncontingent group, there will be one other variable that will vary from the paradigm of this study. In relation to the amount of familiarization hypothesis, the interval of the tone presentation will be lengthened from 100 ms to 300 in all groups. It is inferred that by lengthening such tone duration, the infant will then have a chance to attend to it before the onset of the face. Consequently, results produced from this proposed paradigm should provide more specific information in relation to our alternative hypotheses.

Furthermore, in addition to the behavioral study, an ERP experiment will be implemented using the same paradigm as was used in this current study. However, in place of looking time, infants brain waves in response to the tone will be measured using event related potentials. The task is to determine if mother's face will in turn generate

similar ERP results to the hypothesized value of the food variable.

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APPENDIX A

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 10-17-96 **IRB#:** AS-89-043D

Proposal Title: ELECTROPHYSIOLOGICAL MEASURES IN INFANTS

Principal Investigator(s): David G. Thomas

Reviewed and Processed as: Modification

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:
Modifications reviewed and approved.

This approval is applied to Rima G. Najm's thesis entitled "The Influence of Stimulus Value on Infant Novel Preference".

Signature: _____ Date: July 16, 1997
Chair of Institutional Review Board
cc: Rima G. Najm

VITA

Rima G. Najm

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Master of Science

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