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Investigation of Cultural Bias Using Physiological Metrics: Applications to International Business

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INVESTIGATION OF CULTURAL BIAS USING PHYSIOLOGICAL METRICS:
APPLICATIONS TO INTERNATIONAL BUSINESS

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Industrial and Human Factors Engineering

By

RENEE NICOLE RIGRISH
B.S., Wright State University, 2014

2015
Wright State University

WRIGHT STATE UNIVERSITY

GRADUATE SCHOOL

August 17, 2015

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY
SUPERVISION BY <u>Renee Nicole Rigrish</u> ENTITLED <u>Investigation of Cultural Bias
Using Physiological Metrics: Applications to International Business</u> BE ACCEPTED IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
<u>Master of Science in Industrial and Human Factors Engineering.</u>

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ABSTRACT

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In today's world, many business transactions and interactions are conducted cross-culturally. When going to a business meeting, it is essential avoid a major cultural faux pas in order to not offend your business partners. The Cultural Lens model is used to understand the origins of cultural mismatches. An individual must adjust their approach to a situation to create a cultural match. In adjusting this approach, cognitive biases are a potential result in cross-cultural scenarios. We investigate the Mirror Imaging Bias, which has been found to be a common result of a shortcut to decide how to act in a situation. Physiological metrics were used to see if these biases can be detected in a non-invasive manner. It was found that pupil diameter is a reliable indicator of when Mirror Imaging Bias is present. By understanding how individuals process information and are influenced by Mirror Imaging Bias, we can help create applications as well as provide training to help avoid cultural faux pas.

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I. INTRODUCTION

With international business becoming a normal part of business practice, it has become important to know how to create strong relations by respecting business customs and practices. While we may believe that an unconscious act of crossing a leg over the knee is harmless, other cultures may see this as an intentional act of disrespect (Baker & Long 2003). To prevent cultural faux pas from happening, businesses may hire cultural liaisons which work as not only interpreters, but experts and advisors about do the "dos and don'ts" of each culture.

These cultural faux pas can happen to small businesses or even publicized when the President of a country makes a mistake. At the Asia-Pacific Economic Cooperation summit in Beijing on November 10th 2014, not one, but two presidents made cultural faux pas that went viral. The first being President Barack Obama of the United State of America. President Obama was seen chewing gum throughout the conference which was seen as offensive. While many American citizens know how the President chews Nicorette gum to fight cigarette cravings, the Chinese were all a buzz stating that the president looked like "an idler and "a rapper". However, this was not the worst diplomatic faux pas of the night. President Vladimir Putin of Russia noticed that the Chinese First Lady Peng Liyuan was cold during the outdoor conference, President Putin placed a shawl over her shoulders. Many of us will see this as an act of chivalry, but that is not how the Chinese saw it. Although the First Lady accepted the shawl in the moment, she slipped it off and handed

it to a nearby aide when Putin was facing the other way because the Chinese believed that this act was seen as "inappropriately flirtatious". CNN also reported that this action was considered offensive enough to be erased by the Chinese censorship by the next morning (Keneally, 2014).

It is apparent that while some acts are seen as positive or neutral in one country, they could potentially be very offensive in another county. It is already known that cultural bias is present as people are taught customs of their nation and must become familiar with new customs when visiting another nation. If cultural bias is detectable, it would show that prior consultation with a different nation's customs is needed before traveling abroad or that a cultural liaison may be required to help assist with cultural traditions.

The main goals of this study are as follows: to find if Mirror Imaging Bias has an influence in making decision, to use human performance modeling to show the process of decision making, and to find if physiological measures could detect its presence. The hypothesis is that there will be a greater physiological response present when Theory of Mind is used to assess how to act in a situation over the influence of Mirror Imaging Bias.

II. BACKGROUND

The following sections will review topics such as the Cultural Lens Model, the decision model behind deciding how to react in a cultural situation, and biases that may occur.

CULTURAL LENS MODEL

Culture is defined as "the characteristics and knowledge of a particular group of people, defined by everything from language, religion, cuisine, social habits, music and arts" (Zimmerman, 2015). It is well known that people from different cultural origins may approach situations in different way. These differences can be explained by the Cultural Lens Model as it is able to decipher the origins of cognitive differences (Klein, 2004). Helen Altman Klein remarked, "Intelligent and thoughtful people from different national groups sometimes identify different problems, make different plans, negotiate and coordinate differently, and make different decisions during complex cognitive tasks." (Klein, 2004, p. 250) People are also unable to alter their cognitive processes since the cultural lens is developed outside of a person's awareness. This model also makes the assumption that people of the same origin have shared experiences such as ecological and social experiences.

The Cultural Lens Model can be explained in three parts; Origins, vision and mismatch. Origins are associated with the shared experiences of people in an ecological background. Based on their origin, they are faced with resources available to them as well

as societal pressures of the area. Klein stated, "Because culture is responsive to ecology, similarities in ecology lead to similar practices while differences lead to different practices" (Klein, 2004, p. 255). An example is that if you have a group from China, they will have a different set of experiences than someone who grew up in India.

Vision is associated with behavioral and social differences. These differences influence how a group of people make judgments, reason and make decisions in their daily lives. Based on behavioral and social difference, when a situation arises making a decision is not seen as a conscious choice but doing what is obvious. An example of this could be when someone crosses their legs. While in some cultures this is a neutral actions, other cultures could find this action offensive if the legs are crossed a certain way.

The origin and vision of a person or group of people then lead to a mismatch. A mismatch is made apparent when individuals can "see" how their cultures differ. This can create a conflict between people of different cultures because they do not see eye to eye. By looking through a cultural lens, a person can understand the actions of a different culture by sensitizing themselves to an alternative way of thinking. Although people can alter their actions based on knowledge, they cannot alter their cognitive processes which are affected by their origin and vision (Klein, 2004, pp. 254-268).

Decision making and information processing is where the model below comes into place. Naturalistic decisions are what takes place especially since reactions to a situation are quick. Situational awareness also plays a role where the human needs to be aware of the cultural background. Depending on how culturally aware a person is, they may be able to collect more meaningful information from the situation to make the correct actions.

However, if someone is less culturally aware, they may not take in as much information and thus is less aware.
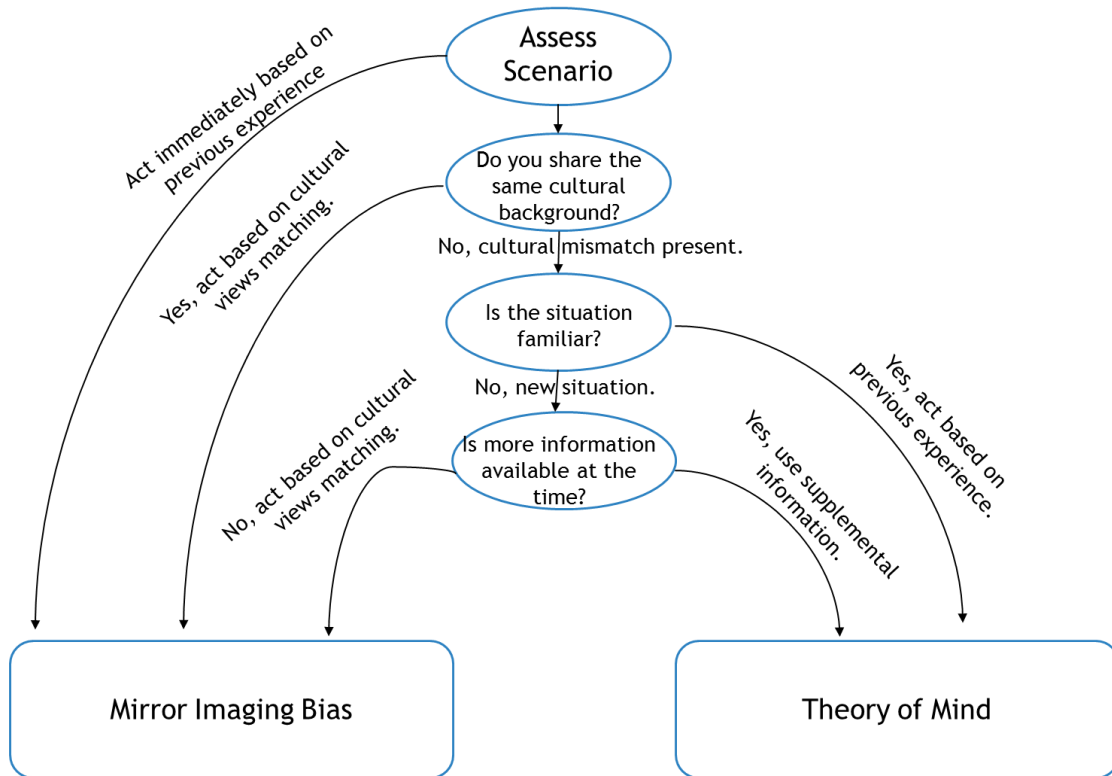
Figure 1: The Bias Influence Decision Model shows the different decision paths that can be made which lead to either the use of Theory of Mind in a cultural scenario or the influence of Mirror Imaging Bias.

The information processing model presented by Wickens (2006) can also help explain how the cultural lens model is processed in the different stages. The information that the human would have to collect would include what culture is presented, what are known customs of that culture, etc. The human then has to assess the specific situation. After perceiving this information, working memory is used to start comprehending the situation at hand.

Once more information from the situation in comprehended, information from long-term memory can be used in order to help make decisions. This could include the following: Do I have past experiences with this culture? Are there appropriate actions? If

I do not know the appropriate action, how should I act? If the correct action for the culture is not known, an individual will use their knowledge of the situation to act in accordance to their culture of origin.

Based on their knowledge, they will make decisions on the actions. Lastly, they will implement the actions based on how they adjusted their mismatch. The human will then go through the process again to continue adjusting their actions for an unfamiliar culture.
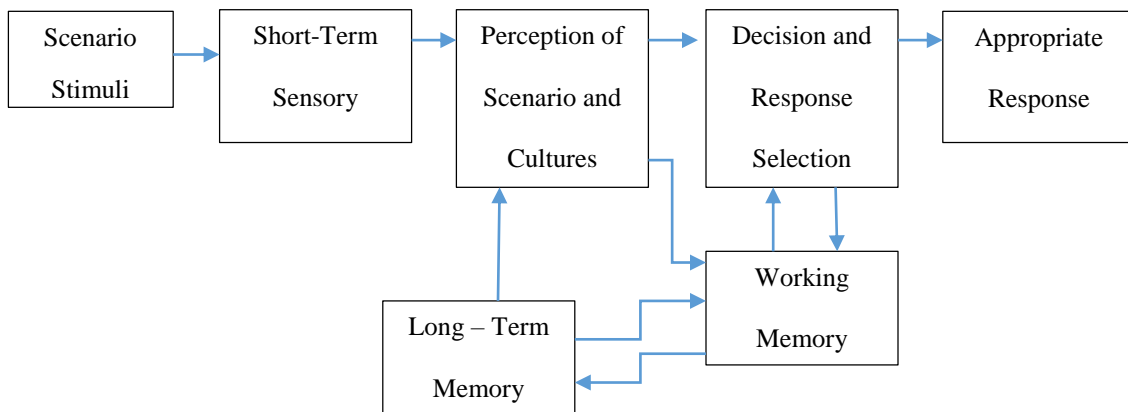
Figure 2: Wickens' Information Processing model was used to determine how information is processed in a cultural scenario (Wickens, 2006). The stimuli from a scenario goes through short-term memory which leads to the perceptions of the scenarios and any other cultures that could be present. This information can be further processed into the working and long term memory. The outcome is that a response is selected and acted out.

There are different aspects of a culture which can be measured that differentiate cultures. Hofstede defined six cultural dimensions which describe different aspects of culture: Power Distance Index, Individualism Index, Masculinity Index, Uncertainty Avoidance Index, Confucian Dynamism, and Indulgence versus Restraint (Diaz, Rusu, Pow-Sang, & Roncagliolo, 2013, p. 2). The Power Distance Index rates how less powerful members of society accept and expect an unequal power distribution within the culture. The Power Distance Index measure shows how a culture views the distribution of power within a society. High levels of Power Distance indicate a hierarchal system while lower

values indicate a system where power is equal. The Masculinity Index is based off of the equality of gender roles. A high Masculinity Index rating will indicate a more "traditional" gender roles where as a low score will blur the gender roles. The Individualism Index ranges from a culture that views themselves as looking after one's self as well as the individual's immediate family. The other side of the spectrum would be collectivism where the culture would show loyalty towards a group of people. The Uncertainty Avoidance Index rates the avoidance of uncertainty which is reflected in different ritual, formality values, punctuality, legal-religious-social requirements and tolerance for ambiguity. Cultures that score high tend to maintain an orderly structure where cultures that score low are more laid back. Confucian Dynamism refers to Long versus Short Term Time Orientations. This implies that a high score would result in an emphasis in acquiring skills and education, working hard, being frugal, patient, and persevering (Marcus & Gould, 2000, pp. 32-46). The last dimension of Indulgence versus Restraint helps bring all of the dimensions together to include all religious, cultural and national paradigms (Diaz, et al., 2013, p. 3).

These dimensions demonstrate the differences between the cultures being tested. When in different situations, individuals from different cultures respond based on their cultural upbringings which are shaped by these different dimensions. For example, the Chinese have a score of 118 in Long Term Orientation versus a score of 29 for an American individual. The Chinese would have a better understanding of planning for long term impacts in a business transaction where as Americans may focus more on the immediate effects.

Power Distance Index	
Arab Countries	80
India	77
USA	40
Individualism Index	
Arab Countries	38
India	48
USA	91
Masculinity Index	
Arab Countries	53
India	56
USA	62
Uncertainty Avoidance Index	
Arab Countries	68
India	40
USA	46
Long-term Orientation Index	
China	118
India	61
USA	29

Klein also identified other cultural dimensions which separate cultures. Mastery versus Fatalism is how dominant a culture feels over their environment. A culture with high Mastery believes that anything can be achieved given the appropriate resources. If Fatalism is high, the culture has a respect for how the environment controls their lives. The next dimension is Achievement versus Relationship which defines how a culture approaches situations in life, work and relationships. A cultural group that is on the Achievement side of the spectrum center on work related activities and accomplishing task goals. A Relationship oriented group focuses on interpersonal dynamics and nurturing relationships. Hypothetical versus Concrete Reasoning defines a culture with Hypothetical Reasoning as seeing many alternate outcomes in future events in order to analyze all

possible situations. Concrete Reasoning still looks at a possible outcome of an event but also integrates constraints to come to a possible conclusion. Attribution is a quality which is used to solve problems by narrowing the selection of approaches and remedies. The two ways a culture can approach Attribution is through root cause or a systems approach. By using root cause, a culture will focus on retraining an individual while systems approach will would not feel comfortable singling out an individual and instead look into group remedies. Lastly, Differentiation versus Dialectical Reasoning define cultures as either sharpening distinctions or evaluating ideas by finding links respectively. Again, all of these cultural dimensions contribute to how individuals from different cultures react to situations.

Cultural competence also plays a part in how people react towards different cultures. Cultural competence is an integration of cross-cultural knowledge, attitudes, and skills are used to improve communications and interactions (Rew, Becker, Cookston, Khosropour, & Martinez, 2003, p. 249). In the study by Rew et al (2003), a scale to measure cultural awareness was developed for use by nursing students. A total of thirty six questions were developed for their scale and there were 5 subscales. The subscales included general educational experience, cognitive awareness, research issues, behaviors/comfort with interactions, and patient care/clinical issues. Each question was rated on a 7-point Likert Scale.

For this study, fifteen of the questions from the aforementioned study were adapted in order to make them applicable to a business setting. They were scored on a 7-point Likert Scale where a score of 1 means that you entirely disagree, 3 means neither agree nor disagree, and 7 means that you entirely agree. The average score was calculated to ensure

that individuals are culturally aware as opposed to seeing how similar the group is as a whole. The Cultural Awareness Statements can be seen in Table 2.

Table 2: Cultural Awareness Statements were used to see how individuals agree with each statement. Based on their response, a conclusion can be made if they are culturally aware and accepting of other cultures.

Cultural Awareness Statements
I believe my beliefs and attitudes are influenced by my culture.
I think my behavior and actions are influenced by my culture.
I often reflect on how culture affects beliefs, attitudes, and behaviors.
When I have an opportunity to help someone, I offer assistance less frequently to individuals of certain cultural background.
I am less patient with individuals of certain cultural backgrounds.
I feel comfortable working with colleagues of all ethnic groups.
I believe people's own cultural beliefs influence their business decisions.
I typically feel somewhat uncomfortable when I am in the company of people from cultural or ethnic backgrounds different from my own.
I think business people's cultural values influence their behaviors in a business setting.
I feel comfortable discussing cultural issues.
My classroom and work experience have helped me become more comfortable interacting with people from cultures.
If I need more information about a client's culture, I would use resources available onsite (e.g., books, videos.)
If I need more information about a client's culture, I would feel comfortable asking people I work
If I need more information about a client's culture, I would feel comfortable asking the client.
I feel uncomfortable working with people from cultural backgrounds different from my own.

By studying people's cultural awareness, it can help identify how open a person would be to different cultural practices.

When individuals approach a situation, several factors play a role in their decisions. There are also biases that may change a person's decision. Salchak (2014) investigated the differences between individuals using Theory of Mind and Mirror Imaging Bias. In cultural situations, individuals tend to either filter the scenario and a response through their own lens or correctly assess a situation and adjust their own lens to match the culture presented.

THEORY OF MIND

Theory of Mind is the ability for an individual to correctly understand other individuals' mental states in a situation including their different beliefs, intents, desires, knowledge, etc. (Call & Tomasello, 2008). While one individual may have a view on the situation, using Theory of Mind means that they understand the view of a different person who may have a very different view than their own. Most individuals are able to achieve this ability by the age of 4 (Perner & Lang, 1999)

A classic example of Theory of Mind is the Sally-Anne false belief tasks (Wimmer & Perner, 1983). This task tests an individual's false-belief understanding by seeing if an individual can predict another's behavior. In this experiment, individuals view a scenario where a character named "Sally" seen an object, like a ball, being placed into a container. After placing the object, Sally leaves the room and a new character named "Anne" enters the room. Anne takes the object and places it in a different container. Sally reenters the room and the individuals are asked to correctly identify where Sally will look for the object based on her beliefs. To correctly display Theory of Mind, the individual will indicate that Sally believes the ball is still in the container she placed it in. If Theory of Mind fails, the

individual would indicate the current location of the ball since they saw Anne switching the ball to a different container.

There are more types of Theory of Mind that can be exhibited by individuals. As stated before, the Sally-Anne task is an example of a false belief task. Schurz, Radua, Aichhorn, Richlan, & Perner, (2014) described other applications of Theory of Mind include trait judgements, strategic games, social animations, mind in the eyes and rational actions.

Trait judgement is where you are given certain traits about a person, such as adjectives, opinions and personal episodes. Based on these traits, an individual can make assumptions about a person. In some experiments, a control statement was given such as showing an adjective and stating if it was written in lower or upper case (Zhu, Zhang, Fan, & Han, 2009). An instance where the individual would have to use Theory of Mind is if the individual is given a statement such as "Tolvan gave her sister a hug." The individual then needs to decide if this statement is consistent with an action such as "friendly" (Ma, Vandekerckhove, Van Overwalle, Seurinck, & Fias, 2011).

Strategic games are where a person has to predict how their opponent will act in order to win the game. This is where an individual must "mind read" in order to decide what would be the best strategic mood. Individuals either compete or cooperate with another player and in most experiments the participants cannot see each other. One study used a game of "stone, paper, scissors". When playing with another person, each player chooses an option and the winner is rewarded. When playing with a computer, the individual is informed of the algorithm that the computer uses. The individual must then choose the correct option to win the game (Gallagher, Jack, Roepstorff, & Frith, 2002).

Social animations use simple shapes to act out scenarios instead of having high level animations with characters. Instead, the shapes act as the character moving across a displays and act out social interactions. The participants would then have to decide if a social interaction occurred between the moving shapes. On the experimental tasks, participants would mainly focus on the social interactions of the blocks, while in a control situation they observe the physical interactions. An example of the social interaction could be two triangles "playing" with each other and the participant would have to explain what interaction they saw (Castelli, Happé, Frith, & Frith, 2000). The controlled task would show two interacting shapes and would ask a question such as, "did the velocity change?" (Blakemore, Boyer, Pachot-Clouard, Meltzoff, Segebarth, & Decety, 2003).

Mind in the eyes is considered an advanced "mind-reading" test. In an experimental task, participants would be shown a picture of a person's eyes and asked to identify which adjective describes a person's eyes. In a control task, individuals would look at the eyes and were asked to identify the age or gender of a person. Schurz et. al. (2014) also stated that some studies would even use a video of the eyes or a complete face instead of just a photo of a pair of eyes.

Lastly, rational action is where participants must determine the actions of the subjects in a story. Participants are asked to determine the goals of the subject in order to predict their outcome. Control tasks ask questions about non-mental parts of a scene rather than predicting an action of a person but predicting something like a physical action. An example of an experimental task could be indicating what a person's gesture is indicating like asking for a bill, hitchhiking, or the gesture being meaningless (Villareal, Fridman, & Leiguarda, 2012). In a controlled task, the participant would see a story such as a person

standing in front of a slide with a ball rolling down it. The participant would have to determine what will happen next like if the ball will knock the person over or if the person will stand next to a ball resting on the ground (Brunet, Sarfati, Hardy Bayle, & Decety, 2000).

Theory of Mind can be broken up into different cognitive components to better understand how it is used in different processes. Schaafsma, Pfaff, Spunt, & Adolphs (2015) came up with a method to deconstruct them reconstruct the process. In the deconstruction stage, basic processes must be well understood in order to move on to more intermediate levels of the tasks. This includes what type of Theory of Mind task, like those previously explained, is present. The way of testing the process must be evaluated by using behavioral tasks. Finally, a relationship of neural networks would be determined to better understand the relationship in neural circuit functions. In the reconstruction stage, the different varieties of Theory of Mind would be mapped in order to understand how they are related in a person's thought process. In this stage, instances where Theory of Mind did or did not occur could be validated. It would also help create revisions of the categories of Theory of Mind used. All of this can be validated using fMRI data to see the activations in the brain map.

While there are many ways to measure cognitive load associated with Theory of Mind, this study uses physiological metrics such as eye tracking, electromyography, galvanic skin response and heart rate variance. These methods are cost effective as they do not require the purchase of large equipment. Using these metrics also involve apparatuses which require very little training on how to use properly. This helps contributes to the ease of use of an operator. Lastly, these methods are non-invasive and cause little to no

discomfort. Eye tracking is recorded with an off body eye tracker and the electromyography, galvanic skin response and heart rate variance are recorded by sensors which are placed on the skin.

MIRROR IMAGING BIAS

Mirror Imaging Bias is described as "the tendency to interpret the actions of others in one's own terms" (Pipes, 1995). When people try to view a scenario and make conclusions based on their own personal experiences, they make an assumption that others think the same as themselves and share similar experiences, and thus use Mirror Imaging Bias. Salchak (2014) noted that is the most common bias that is commonly experienced by intelligence analysts and could be dangerous in different situations.

One reason for Mirror Imaging Bias to happen is the failure of Theory of Mind. Sometimes, instead of being able to understand another person's beliefs, individuals may project their own in order to decide an appropriate action. It is a mental shortcut an individual may take in order to avoid a high cognitive load. Theory of Mind would have a higher cognitive load because it requires individuals to comprehend and understand the intentions and actions of another individual. Mirror Imaging Bias would bypass the part where another person's views would be taken in account; instead an individual would carry out a scenario based on their own views which is a more natural response.

In Schaller's (2008) paper *Failed Mirroring as a Cultural Phenomenon,* she states that "a cultural dimension also exists in mirroring or failed mirroring. When, in daily human interactions, persons have reflected back to them not themselves but the cultural assumptions of others, they experience failed mirroring". The Cultural Lens Model

presented by Klein explains the differences that can lead to a cultural mismatch (Klein, 2004).

Cultural mismatch and the use of Mirror Imaging Bias as opposed to Theory of Mind can lead to misunderstandings within a business setting. Another instance where this has happened was between a group of French and Chinese individuals. Parrenin, De Maeyer, Fack, Van Assche, & Witlox (2012) interviewed Chinese and French individuals to find where the cultural difference existed. Parrenin et al. (2012) found that adapting to a new environment at an earlier stage could lead to a misunderstanding between the cultures because it takes time for the differences to become apparent. An example being that the Chinese do not ask questions at the end of the meeting (Parrenin et al., 2012). Where many cultures would assume that everything is understood in this meeting, this could still mean that there are some aspects of the meeting that are not completely understood by the Chinese individuals. By assuming and projecting your own cultural practices on another culture, you are using Mirror Imaging Bias.

III. METHODOLOGY

EXPERIMENTAL DESIGN

This study was designed to test how participants interact with different cultural scenarios in order to determine what type of bias is present. Answers provided by the participant were recorded and analyzed.

As stated before, Mirror Imaging Bias and Theory of Mind can occur when trying to predict the actions of another individuals. Mirror Imaging Bias occurred when the participant would give an answer on how a person should act based on their own personal experience. Essentially, they answered the question based on how they would act if they were in that situation. When answering for the other individuals in the situation, the answers will be compared to how they answered for themselves in the same situation to see if they exhibit their own cultural bias as opposed to attempting to modify their cultural lens to adjust to the mismatch. If they are able to project Theory of Mind correctly, the participant would have the ability to take the perspective of a person from a separate cultural background. This would be apparent if the participant is able to adjust their cultural mismatch to predict appropriate actions of the people in the scenario.

Different physiological metrics have proven to show indications of change in cognitive load. Once Theory of Mind and Mirror Imaging Bias has been identified, these metrics were analyzed in order to see if there is any significant difference between measurements for the two biases.

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PARTICIPANTS

The cultures recruited for this study were American, Chinese, Indian and Middle Eastern. Fifty participants aged 18 to 40 were recruited from the Wright State University community. These subjects were comprised of the following groups: 20 Americans (10 male, 10 female), 20 Indians (10 male, 10 female), 7 Middle Eastern (4 Males, 3 Females), and 3 Chinese (2 Male, 1 Female). A graphical representation of the groups can be seen in Figure 3. All participants had either normal or corrected vision.
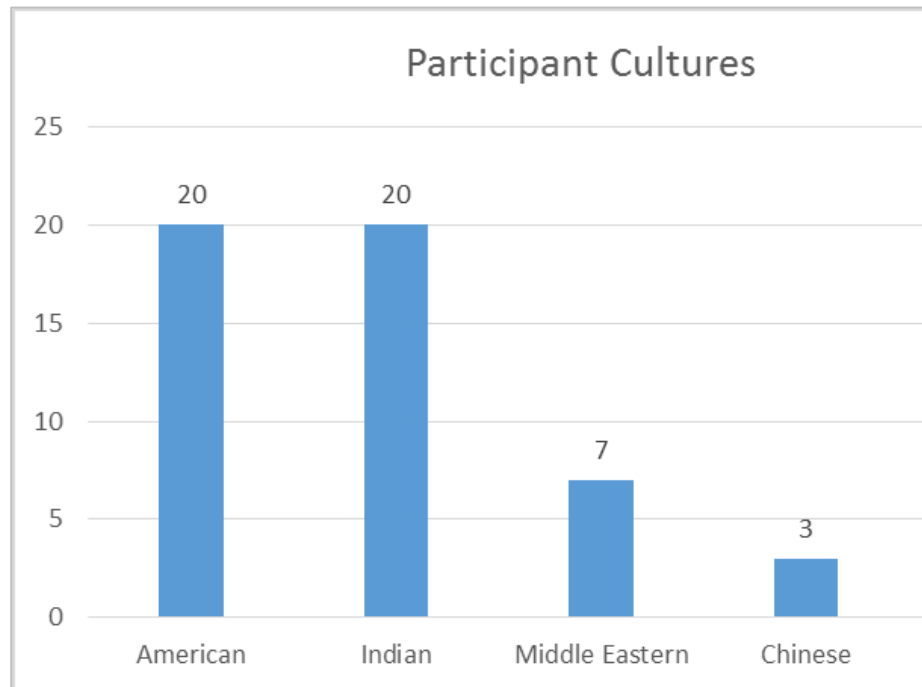
Figure 3: Summary of Cultural Groups. There were a total of 20 Americans, 20 Indians, 7 Middle Easterns and 3 Chinese participants in this study.

APPARATUS

Testing of the scenarios was performed at Wright State University (WSU) and the study was approved by the WSU Institutional Review Board (IRB). The software used included the Tobii Studio eye tracker and the CAPTIV-L7000 system. Tobii was be used to collect and record subjects' eye tracking information such as gaze, number of fixations,

and pupil dilation while CAPTIV-L7000 collected galvanic skin response (GSR), heart rate variance (HRV), and electromyography (EMG) of the medial frontalis and the right-unilateral EMG of the orbicularis oculi.

STIMULI

The participants were asked to view the scenario with audio about what is happening in the picture. They were then asked a question about the scenario from the perspective of the "self" and "other". This helps determine how an individual would act naturally in a situation and if they are able to use Theory of Mind when answering for the other culture.

Scenarios were created based on research from several etiquette guides based on how to do proper business in each of these regions. Actions in the scenarios included dining etiquette, greetings, conversational etiquette and meeting etiquette. An example of the questions for the "self" and "other" are seen in Figures 4 and 5 respectively, and the list of all questions and scenarios may be seen in Appendix D.

Figure 4: An example of a question posed for the self in a scenario.

Figure 5: An example of a question posed for "other" in a scenario.

PROCEDURE

Participants start the experiment by filling out an informed consent. Once consent was received, the CAPTIV sensors were placed on the individual and tested for functionality. As familiarity with cultures plays a significant role in this study, participants were asked in a pre-questionnaire about what cultures they identify with, cultures they have been exposed to, as well as what level of exposure occurred. Participants also noted how long they have been exposed to that culture. A second pre-questionnaire was also administer to determine an individual's cultural awareness. The eye tracking system was then calibrated to the participant.

Before being presented with the experimental stimuli, participants viewed a demonstration of a scenario in which they were asked to answer a simple question about the picture presented.

There were 10 images of each culture which totaled to 30 images presented. Participants were exposed to the each of the images with an accompanying audio describing the actions in each scenario. Each audio segment lasted between seven and

twelve seconds. The culture being presented was either stated in the audio segment and/or was shown by the people present in each image. After each of the audio files were completed, the participant was presented with a question which was superimposed on to the image. The images were randomized within each cultural group. The order in which the cultures were presented was also randomized.

Each image was presented twice in order to explore the differences of answering questions about the self and answering questions about other people's actions in accordance to the culture presented. Since participants were shown each image twice, this totaled in 60 scenarios presented. Participants responded by using the keyboard with the up arrow key corresponding to "Yes" and the down arrow key corresponding to "No." Image order was randomized in order to minimize a learning effect.

Each of the participants were exposed to the randomized scenarios twice. The first time they were asked questions based on how they would act (self) and the second time they were asked based on how the people in the scenarios should have acted (other). Participants were asked similar questions about the same scenarios in order to distinguish the presence of Mirror Imaging Bias as opposed to Theory of Mind.

A post questionnaire was administered to determine how familiar the participants were with each of the presented cultures. Participants also indicated if they used any information about the cultures to make their decisions.

The timeline of the experiment is shown in Figure 5. The experiment lasted for approximately 30-45 minutes.
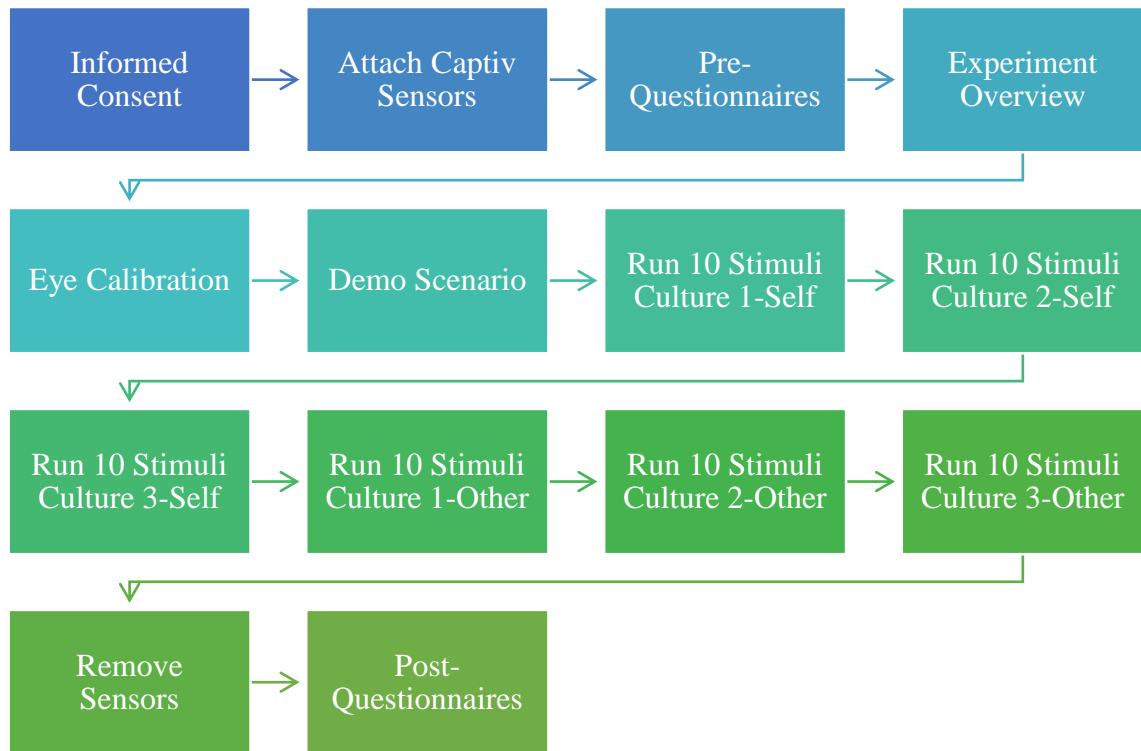
Figure 6: Experiment Timeline. The timeline for each run began with an informed consent. The CAPTIV sensors for EMG, GSR, and HRV were then placed on the participants. A pre-questionnaire was administered and an overview of the experiment was given verbally. The eye calibration was done with the Tobii eye tracker. The participant was led through a demo scenario to make sure they had a full understanding of the procedure. The stimuli was then presented once confirmation of understanding was obtained from the participant. The stimuli was presented in groups of ten. Once all stimuli was presented, the sensors were removed and a post-questionnaire was administered. The entire process too approximately between 30-45 minutes.

RESEARCH COMPONENTS

In this study, the following cultural groups were chosen; American, Indian, Middle Eastern and Chinese. These cultures were chosen based off of the cultural populations present at Wright State University. The scenarios comprised of scenes from business with individuals from India, the Middle East, and China.

PHYSIOLOGICAL METRICS

Cognitive load is described as a level of perceived effort which may be associated with cognitive tasks such as learning thinking and reasoning (Shi, Ruiz, Taib, Choi, & Chen, 2007). There are many tasks which require thinking and reasoning in everyday life

and thus, require a cognitive load to be present. Cognitive load may also be measured using different physiological metrics. The physiological metrics being used in this experiment are as follows: pupil diameter, number of fixations, electromyography of the medial frontalis and right-unilateral, and galvanic skin response. Each metric will be further explained and related to cognitive workload in this section.

PUPIL DIAMETER AND NUMBER OF FIXATIONS

Pupil diameter measures the dilation of the eyes in millimeters. The pupil diameter of the left and right eyes were measured using Tobii Studio eye tracker. Pupil size has shown to directly reflect processing load and mental effort in individuals (Moresi et al., 2008; found in Causse, 2009).

One study connects pupil diameter with cognitive load used a Stroop test to control the cognitive involvement of the participants (Ren, Barreto, Gao, & Adjouadi, 2012). The average pupil diameter over a task was measured and then different algorithms were used to predict which level of the cognitive load was present during that time. It was found from these algorithms that the pupil diameter has an average rate of 85.86% at predicting the correct cognitive load present. One algorithm had a success rate of 89.08% to classify the cognitive load (Ren et al., 2012). This rate of accuracy shows that the pupil diameter is a reliable metric to measure cognitive load.

When looking at pupil dilation in conjunction with blink, it was found that pupil dilation happens during sustained information processing (Siegle, Ichikawa, & Steinhauer, 2008). It was also found that pupil change is higher during dynamic tasks which require problem solving in changing settings (Causse, Senard, Demonet, & Pastor, 2009). It also requires a high cognitive demand when individuals confabulate a response rather than tell

the truth. When the individuals fabricate a lie to answer a question as opposed to truthfully answering the same question, pupil size increased which indicates an increase in cognitive load (Dionisio, Granholm, Hillix, & Perrine, 2001). Through various studies, it was found that pupil diameter is a reliable metric to use when measuring the cognitive load present during a task.

A fixation if where the eye remains still for a period of time to look at one spot in the field of vision (Holmgvist, 2011). However, the eye does not remain completely still as there a micro movements called tremors which naturally occur. In between each fixation, a saccade occurs. Saccades are defines as the "rapid motion of the eye from one fixation to the other" (Holmgvist, 2011, p. 23).

It was found that "participants would show additional fixations on the units reflecting additional cognitive effort to inhibit the interfering information in incompatible trials" (Moeller et al. 2009; found in Huber et al., 2013, p. 540). Fixation count was also found to be at its' highest when there was either a highly complex task or the interface was complex itself (Wang, Sa, Liu, Cao, & Ma, 2014). It is also important to note that individuals fixate more often on informative objects within a scene in order to gather more information (Loftus & Mackworth, 1978). This leads to a conclusion that more fixations could indicate the presence of a higher level of cognitive load.

ELECTROMYOGRAPHY

Electromyography (EMG) is measure by placing sensors on the skin's surface. A set of triodes was placed on the forehead and right temporal area to measure the muscle activity of the medial frontalis and orbicularis oculi respectively. The CAPTIV EMG sensors measure the muscles' contractions and resting periods in microvolts. The medial

frontalis on the forehead records movement such as furrowing the brow. Furrowing the brow may also be a sign of concentration or confusion which could indicate a higher cognitive load (Salchak, 2014). The orbicularis oculi can measure movement of squinting or blinking the eyes. Since Blinks tend to occur more frequently following periods of cognitive load, such as early sensory processing and after a sustained period of information processing (Siegle et al., 2008).

Several methods may be used to analyze EMG data. Salchak mentioned that taking the average or root mean square of the EMG data over a period of the time of a task may be used as a valid method to quantify the muscle activity (Salchak, 2014, p. 41-42). For this study, the root mean square method will be utilized to calculate the muscle activity occurring in the medial frontalis as well as the orbicularis oculi.

GALVANIC SKIN RESPONSE

Galvanic Skin Response (GSR) measures the conductivity of human skin in microSiemens. It is used by placing sensors on either the fingers or the palm. In this study, two CAPTIV GSR sensors were placed on the middle and index finger pads on the left hand of the participant in order to measure the skin conductance. Skin conductance shows a direct indication of the sympathetic nervous system. When the sympathetic nervous system is aroused, the skin conductance increases.

GSR has been used to test the cognitive load of a participant in many studies. In a study testing the physiological implications of different cognitive loads, GSR was examined to better understand the accuracy of this measurement (Ren et al., 2012). A Stroop test was administered and the GSR was recorded by taking an average of the amplitude of each GSR response within a segment. It was found that they could correctly

categorize the cognitive load from the GSR an average of 60.66% of the time (Ren et al., 2012).

Another study tested the GSR measurements while performing different virtual reality driving tasks (Lee & Kim, 2009). In this study, a subjective score on a 5 point Likert scale was also taken after each driving scenario to be compared with the measured GSR. Using and ANOVA analysis, it was found that there was a significant difference between the less demanding task of driving straight or on a curve and the more demanding task of driving through an accident condition (Lee & Kim, 2009). This supports how with a more demanding task that there are higher GSR levels.

One study found that modeling the GSR does not help predict the GSR levels since GSR levels may fluctuate (Bach, Friston, & Dolan, 2013). In a study done by Shi et al. (2007), they designed an experiment to see if there was a difference in cognitive load for administering different traffic tasks using different interface interactions. In order to compare if there is a change in cognitive load, a mean GSR value was taken over each task. It was found that the more cognitively demanding tasks had a high GSR mean value. Another study by Conway, Dick, Li, Wang, Chen (2013) uses a mean GSR as well to indicate a measure for cognitive load. They found that there was a significant difference between the cognitive load in the no-stress condition but not within a stress condition (Chen et al., 2013).

HEART RATE VARIANCE

Heart rate is the measurement of the rate which the heart beats in beats per minute. Many recent studies showed that Heart Rate Variance (HRV) can be influenced workload as well as emotional responses. CAPTIV measures heart rate through the use of a thoracic

belt. HRV is defined as the "amount of fluctuate around the mean heart rate" (Christensen & Wright, 2014) and may be used as a way to quantify mental workload during cognitively demanding tasks.

Causse found that heart rate becomes more elevated during logical tasks (Causse et al., 2009). These logical tasks contained processes which contained everyday problem solving. HRV was also found to be more sensitive to perceptual task demands over attentional demands (Lugue-Casado, Zabala, Morales, Mateo-March & Sanabria, 2013). While working on a complex cognitive task, the heart rate variability was able to indicate a moderate level of arousal (Murray & Russoniello, 2012). Lee & Kim also found that the heart rate showed similar trends to the GSR measurements when measuring cognitive load (Lee & Kim, 2009). The heart rate showed a significant difference between the different difficulties of the driving task with higher heart rates indicating higher cognitive loads.

Although HRV is use in detecting cognitive load, the data collected was unreliable and thus will not be included in analysis.

IV. RESULTS

Due to a data recording error, one American female's results were not recorded correctly and thus the data was unusable. Another Indian female was found to answer the questions with response times of less than 0.1 seconds which would not allow time to read and comprehend the questions. Her data was omitted from analysis due to these impractical response times not allowing a genuine response.

The bias of each individual was determined by comparing how an individual answered the scenario when answering for "self" perspective versus answering the scenario based on "other" perspective.

If the answers for "self" perspective and "other" perspective matched, this indicates that the individual did not change their way of thinking in the scenario and thus Mirror Imaging Bias is implemented. If a person is from a certain culture and they answer questions based on their culture, they will not have to change their way of thinking so the answer will be categorized as Mirror Imaging Bias.

If the answers for "self" perspective and "other" perspective did not match, this indicates that the individual felt that there was a cultural difference present and adjusted their answer accordingly. This indicates that the individual used Theory of Mind to try to answer the scenarios from the perspective of the individual.

Overall results showed that Mirror Imaging Bias (62.45%) was used by participants almost twice as frequently as Theory of Mind (37.55%). The comparison of bias influences can be seen in Figure 7.
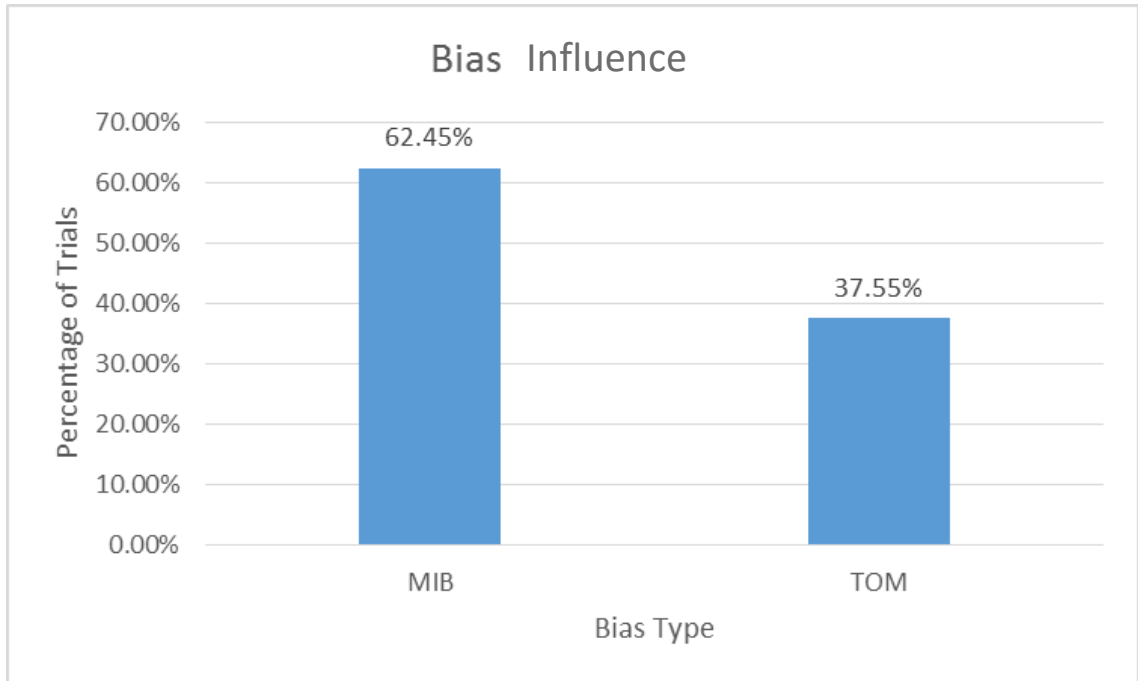

Figure 7: Participants were predominantly influenced by MIB. MIB occurred 62.45% of the time across all participants while TOM occurred 37.55% of the time.

The American, Indian and Middle Eastern group were influenced by MIB 60.20%, 62.30% and 64.80% of the time, which is fairly similar. The Chinese group was influenced by MIB 73.30% of the time which is not as similar as the other groups. However, the small sample size of these two groups may be the reason that these percentages are different than other groups. The comparison of bias influence by cultural group can be seen in Figure 8.

Bias influence was also compared by gender. Females showed were influenced by MIB 61.70% of the time and males were influenced by MIB 63.10%. These numbers are very similar to the overall bias influence and can be seen in Figure 9.
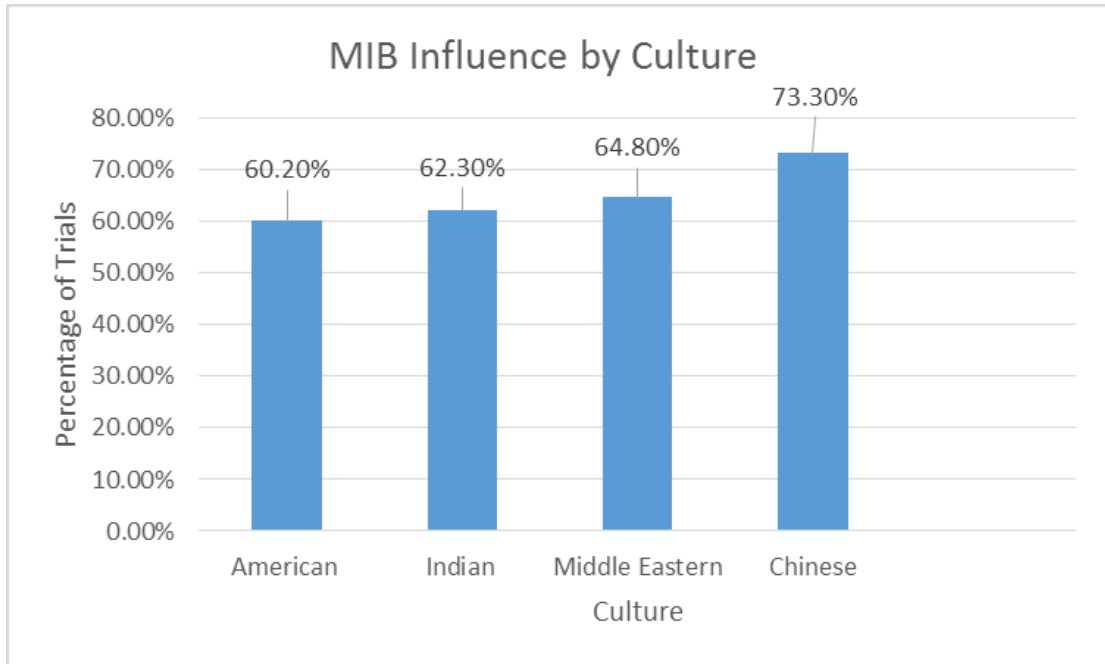
Figure 8: Each culture was influenced by MIB a similar amount of times. Americans were influenced 60.2% by MIB, Indians were influenced 62.3%, Middle Easterns were influenced 64.8% and Chinese were influenced 73.3%.
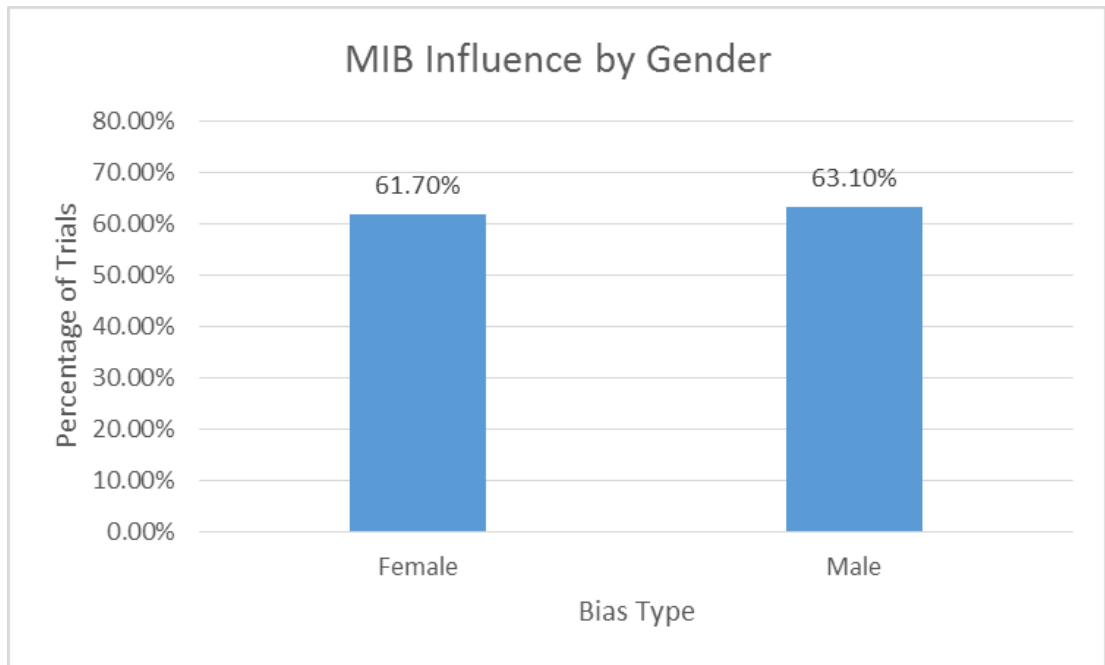

Figure 9: Both Females and Males were influenced by MIB close to the average 62.45% of the entire group. Females were influenced 61.7% of the time while males were influenced 63.1%.

Participants stated that when answering questions on a cultural scenario they were not familiar with, they would apply their own past experiences and knowledge to the

30

scenario. These past experience could be their own experiences where they have dealt with a situation in their personal lives in accordance to their culture. There are also instances where people stated that they tried to make assumptions on how to apply their action based on observations of participants from that culture in real life as well as television shows and movies.

The cultural awareness questions were used to determine if the participants were culturally aware. A score of 7 indicated that participants strongly agreed with the statement while a score of 1 indicated that they strongly disagreed with the statement. A score of 4 meant that the participants neither agreed nor disagreed with the statement. The scores suggest that the participants as a group are accepting of other cultures when looking at the average scores. The standard deviation shows that the range of scores still fall within being culturally aware for each statement. All participants' scores indicate that they were all culturally aware.

Table 3: Cultural Dimension Statements and Answers. There were no outliers in any of the responses from the participants. All participants' scores indicate that they were all culturally aware.

Cultural Awareness Statements	Average Response	Standard Deviation
I believe my beliefs and attitudes are influenced by my culture.	5.41	1.25
I think my behavior and actions are influenced by my culture.	5.18	1.18
I often reflect on how culture affects beliefs, attitudes, and behaviors.	4.96	1.43
When I have an opportunity to help someone, I offer assistance less frequently to individuals of certain cultural background.	2.27	1.58
I am less patient with individuals of certain cultural backgrounds.	2.63	1.55
I feel comfortable working with colleagues of all ethnic groups.	6.27	0.96
I believe people's own cultural beliefs influence their business decisions.	4.65	1.69
I typically feel somewhat uncomfortable when I am in the company of people from cultural or ethnic backgrounds different from my own.	2.94	1.65
I think business people's cultural values influence their behaviors in a business setting.	4.51	1.45
I feel comfortable discussing cultural issues.	5.63	1.50
My classroom and work experience have helped me become more comfortable interacting with people from cultures.	6.39	0.80
If I need more information about a client's culture, I would use resources available onsite (e.g., books, videos.)	5.37	1.46
If I need more information about a client's culture, I would feel comfortable asking people I work	5.57	1.32
If I need more information about a client's culture, I would feel comfortable asking the client.	5.35	1.45
I feel uncomfortable working with people from cultural backgrounds different from my own.	1.71	0.86

RESPONSE TIME

Response times were calculated as the time it took a participant to answer a question in seconds. The time was recorded from when the question first appeared on the screen to when the participant chose an answer.

A one-way ANOVA analysis showed that for the Response Time there was a significant difference between the cultures (p-value <0.0001), as well as bias types (p-value = 0.0380) when using an alpha of 0.05. There was no significant difference or with the interaction of culture and bias (p-value = 0.7329).

The connecting letters report in Figure 10 shows that the Middle Eastern group is significantly different from all groups other than Indian. The Indian group is significantly different from the American group. The American group is significantly different from all groups except the Chinese group. The Chinese group is significantly different with the Middle Eastern group.

Level			
Middle Eastern	A		
Indian	A	B	
American			C
Chinese		B	C

Figure 10: Connecting Letter Report for Cultures in Response Time. The Middle Eastern group is significantly different from all groups other than Indian. The Indian group is significantly different from the American group. The American group is significantly different from all groups except the Chinese group. The Chinese group is significantly different with the Middle Eastern group.

Mirror Imaging Bias exhibits a lower response time (mean value of 3.08 seconds) than Theory of Mind (mean value of 3.52 seconds). The power of the test for bias was 0.5462. The Least Square means plot in Figure 11 shows that for each culture that Theory of Mind has a higher response time with the exception of the Chinese group.
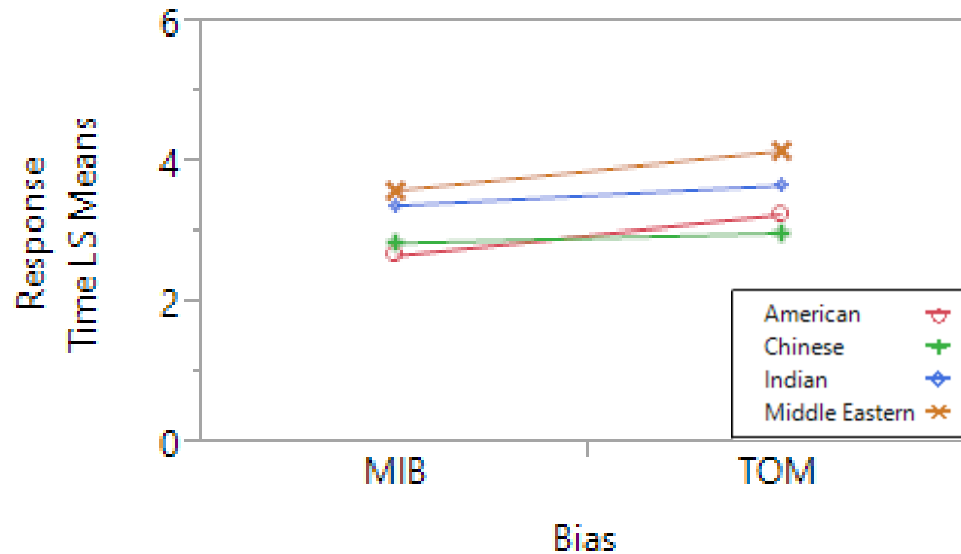
Figure 11: LS Means Plot comparing Response times for each culture according to MIB and TOM shows a trend of TOM consistently higher than MIB for all groups except Chinese.

Next we look at the physiological measures to see is there is difference when participants' response with MIB.

PUPIL DIAMETER

Pupil diameters were taken at the time that the participant answered a question. A baseline pupil diameter was also taken for each participant and was subtracted from the pupil diameter at the time when the participants answered the questions in order to account for differences in pupil diameters between participants. This measurement will be referred to as Pupil Delta. The unit for the pupil diameters is in millimeters.

A one-way ANOVA analysis showed that for the Left Pupil Delta there was a significant difference between the cultures (p-value <0.0001), and with the bias types (p-value <0.0001) when using an alpha of 0.05. There was no significant difference between the interaction of culture and bias (p-value = 0.2831).

The connecting letters report in Figure 12 shows that the Chinese group is significantly different from all groups except Middle Eastern. The Middle Eastern group is significantly different from the Indian group. The American group is significantly different from all groups except the Middle Eastern group. The Indian group is significantly different from all groups.

Level		
Chinese	A	
Middle Eastern	A	B
American		B
Indian			C

Figure 12: Connecting Letters Report for Cultures in Left Pupil Diameter. The Chinese group is significantly different from all groups except Middle Eastern. The Middle Eastern group is significantly different from the Indian group. The American group is significantly different from all groups except the Middle Eastern group. The Indian group is significantly different from all groups.

There is a significant difference between Mirror Imaging Bias and Theory of Mind where Mirror Imaging Bias shows a lower change in pupil diameter (mean value of 0.41mm) than Theory of Mind (mean value of 0.49mm). The power of the test for bias was 0.9834. The Least Square means plot in Figure 14 shows that for each culture that Theory of Mind has a higher difference in pupil diameter.

A one-way ANOVA analysis showed that for the Right Pupil Delta there was a significant difference between the cultures (p-value = 0.0002), and with the bias types (p-value < 0.0001) when using an alpha of 0.05. There was no significant difference between the interaction of culture and bias (p-value = 0.2170).

The connecting letters report in Figure 13 shows that the Chinese group was significantly different from all cultures. The American group was not significantly different

from Middle Eastern group. There was also no significant difference between the Indian

and Middle Eastern group.

Level		
Chinese	A	
American		B
Middle Eastern		B C
Indian		C

Figure 13: Connecting Letters Report for Cultures in Right Pupil Diameter. The Chinese group was significantly different from all cultures. The American group was not significantly different from Middle Eastern group. There was also no significant difference between the Indian and Middle Eastern group.

There is a significant difference between Mirror Imaging Bias and Theory of Mind where Mirror Imaging Bias shows a lower change in pupil diameter (mean value of 0.46mm) than Theory of Mind (mean value of 0.54mm). The power of the test for bias was 0.9906. The Least Square means plot in Figures 15 show that for each culture that Theory of Mind has a higher difference in pupil diameter.
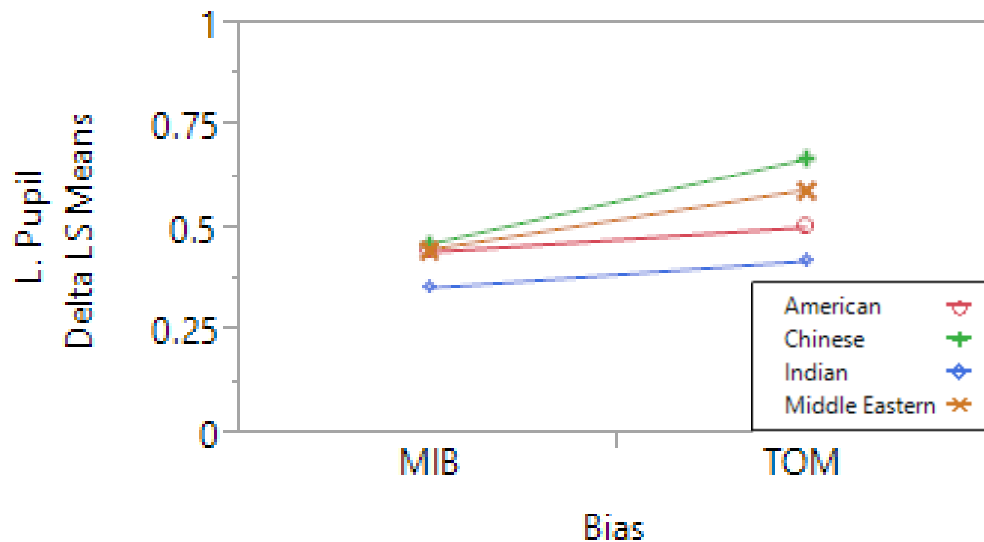

Figure 14: LS Means Plot comparing Left Pupil Delta for each culture according to MIB and TOM shows a trend of TOM consistently higher than MIB.
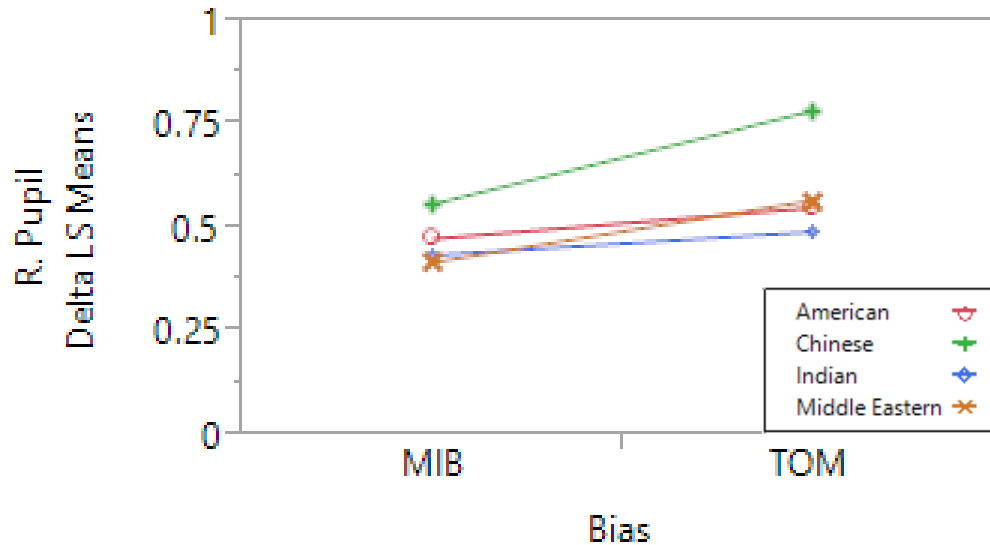
Figure 15: LS Means Plot comparing Right Pupil Delta for each culture according to MIB and TOM shows a trend of TOM consistently higher than MIB.

FIXATION COUNT

Fixation counts were extracted from the number of fixations from the participant while answering a question. Fixations were recorded starting when the questions first appeared to when the participant answered. The minimum time for a fixation was defined as 60 milliseconds.

When looking at the heat maps, participants focus on details such as the individuals' faces and object which may give more information in the scenario. The scenario in Figures 16 and 17 asked a question about how to accept a business card. In Figure 16, Theory of Mind is used and it seems that participants fixated more on the business card in this scenario than the faces since the actions in the scenario pertained to the business card. In Figure 17, Mirror Imaging Bias is influenced and participants seemed to fixate more on the faces instead of the business card in this scenario. This could be due to level of expertise and

knowing what information is the most relevant to the scenario since individuals fixate on

objects which give more meaning to a scenario.

Figure 16: An example of a heat map from a scenario when Theory of Mind was implemented. Participants would focus on the question and gather additional information from the faces of people in the scenario and any other relevant objects to the scenario. Individuals who used Theory of Mind seemed to fixate more on the business card in this scenario since the actions in the scenario pertained to the business card.

Figure 17: An example of a heat map from a scenario when Mirror Imaging Bias was influenced. Participants would focus on the question and gather additional information from the faces of people in the scenario and any other relevant objects to the scenario. Individuals influenced by Mirror Imaging Bias seemed to fixate more on the faces instead of the business card in this scenario.

A one-way ANOVA analysis showed that for the Fixation Count there was a significant difference between the cultures (p-value <0.0001) when using an alpha of 0.05. There was also a significant difference between the bias types (p-value = 0.0140), but there was no significant difference with the interaction of culture and bias (p-value = 0.3075).

The connecting letters report in Figure 18 shows that the Chinese, Indian and Middle Eastern group was not significantly different from each other. The American and Chinese group was not significantly different from each other.

Level		
Middle Eastern	A	
Indian	A	
Chinese	A	B
American		B

Figure 18: Connecting Letters Report for Cultures in Fixation Count. The Chinese, Indian and Middle Eastern group was not significantly different from each other. The American and Chinese group was not significantly different from each other.

Mirror Imaging Bias exhibits a lower number of fixations (mean value of 13.5) than Theory of Mind (mean value of 15.0). The power of the test for bias was 0.6912. The Least Square means plot in Figure 19 shows that for each culture that Theory of Mind has a higher difference in the number of fixations.
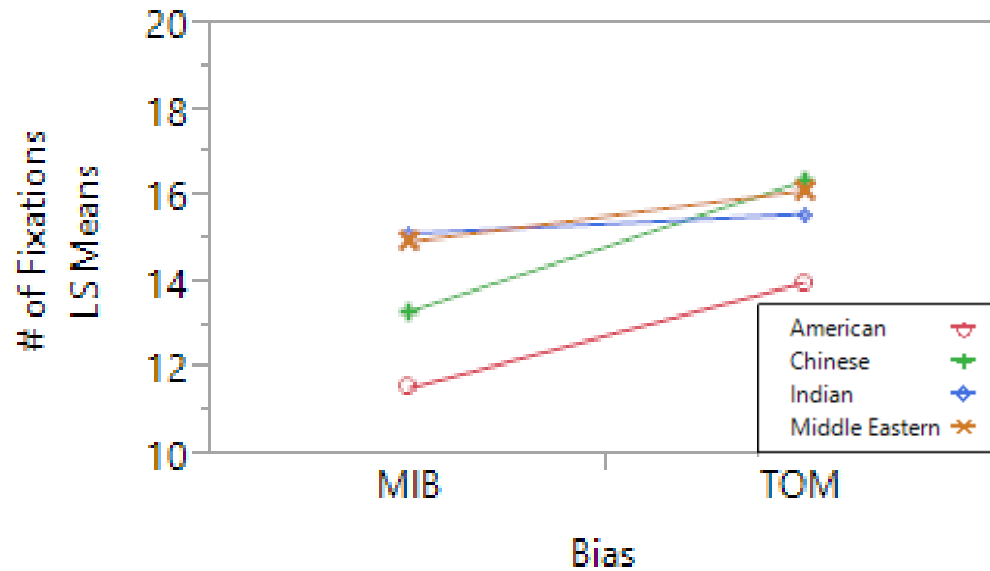
Figure 19: LS Means Plot comparing Number of Fixations for each culture according to MIB and TOM shows a trend of TOM consistently higher than MIB.

EMG MEDIAL FRONTALIS

The EMG data from the Medial Frontalis was extracted using a Root Mean Squared value over the period when the participant was answering the question. A baseline EMG value was subtracted from the EMG value of each scenario to obtain how much the EMG value decreased or increased for each scenario. This was also done in order to account for differences in individual EMG readings between participants.

A one-way ANOVA analysis showed that for the EMG Medial Frontalis there was a significant difference between the cultures (p-value <0.0001) when using an alpha of 0.05. There was no significant difference between the bias types (p-value = 0.2810) and with the interaction of culture and bias (p-value = 0.9903).

The connecting letters report in Figure 20 shows that the American group is significantly different from all groups. The, Indian and Chinese groups are not significantly

different from each other. The Middle Eastern group is significantly different from all groups.

Figure 20: Connecting Letters Report for Cultures in EMG Medial Frontalis. The American group is significantly different from all groups. The, Indian and Chinese groups are not significantly different from each other. The Middle Eastern group is significantly different from all groups.

There is no significant difference between Mirror Imaging Bias and Theory of Mind. However, Mirror Imaging Bias exhibits a lower EMG (mean value of 0.14 micro volts) than Theory of Mind (mean value of 0.28 micro volts). The power of the test for bias was 0.19. The Least Square means plot in Figure 21 shows that for each culture that Theory of Mind has a higher difference in EMG differences for all groups.
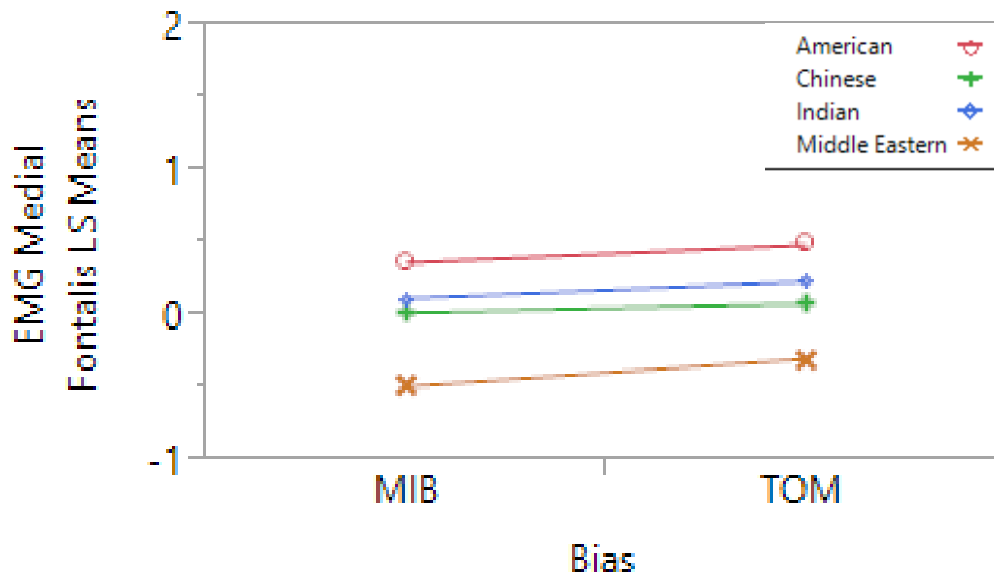

Figure 21: LS Means Plot comparing EMG Medial Frontalis for each culture according to MIB and TOM shows a trend of TOM consistently higher than MIB.

EMG ORBICULARIS OCULI

The EMG data from the Orbicularis Oculi was extracted using a Root Mean Squared value over the period when the participant was answering the question. A baseline EMG value was subtracted from the EMG value of each scenario to obtain how much the EMG value decreased or increased for each scenario. This was also done in order to account for differences in individual EMG readings between participants.

A one-way ANOVA analysis showed that for the EMG Orbicularis Oculi there was a significant difference between the cultures (p-value <0.0001) when using an alpha of 0.05. There was no significant difference between the bias types (p-value $= 0.8872$) and with the interaction of culture and bias (p-value $= 0.7472$).

The connecting letters report in Figure 22 shows that the Indian group is significantly different from all. The American, and Chinese groups are not significantly different from each other. The Chinese, and Middle Eastern groups are not significantly different from each other.

Level		
Indian	A	
American	B	
Chinese	B	C
Middle Eastern		C

Figure 22: Connecting Letters Report for Cultures in EMG Orbicularis Oculi. The Indian group is significantly different from all. The American, and Chinese groups are not significantly different from each other. The Chinese, and Middle Eastern groups are not significantly different from each other.

There is no significant difference between Mirror Imaging Bias and Theory of Mind. However, Mirror Imaging Bias exhibits a lower EMG (mean value of 1.59 micro

volts) than Theory of Mind (mean value of 1.7 micro volts). The power of the test for bias was 0.0523. The Least Square means plot in Figure 23 shows that there is no general trend between the cultures and bias type.
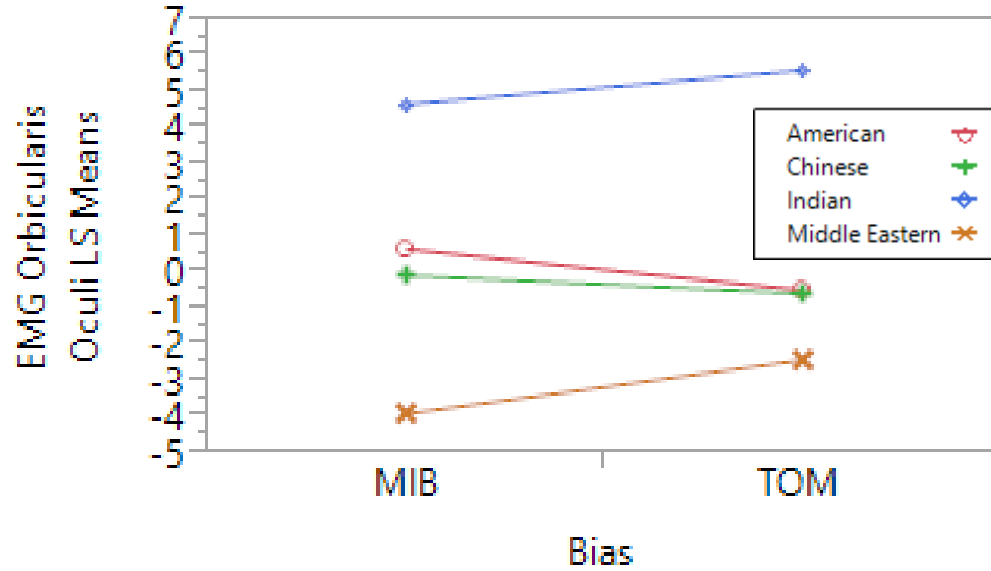

Figure 23: LS Means Plot comparing EMG Orbicularis Oculi for each culture according to MIB and TOM shows no general trend. This is reflected in the ANOVA test showing that there is no significant different between the EMG Orbicularis Oculi and bias type.

GALVANIC SKIN RESPONSE

The galvanic skin response (GSR) data was extracted by taking the average reading over the period when the participant was answering the question. A baseline GSR value was subtracted from the GSR value of each scenario to obtain how much the GSR value decreased or increased for each scenario. This was also done in order to account for differences in individual GSR readings between participants.

A one-way ANOVA analysis showed a significant difference between the cultures (p-value <0.0001) when using an alpha of 0.05. There was a significant difference between the bias types (p-value = 0.0198), but not with the interaction of culture and bias (p-value = 0.1056).

The connecting letters report in Figure 24 the American group is significantly different from all groups. The Middle Eastern, Indian, and Chinese groups are not significantly different from each other.

Level		
American	A	
Chinese		B
Indian		B
Middle Eastern		B

Figure 24: Connecting Letters Report for Cultures in GSR. The American group is significantly different from all groups. The Middle Eastern, Indian, and Chinese groups are not significantly different from each other.

There is no significant difference between Mirror Imaging Bias and Theory of Mind. However, Mirror Imaging Bias exhibits a lower GSR (mean value of 0.39 micro Siemens) than Theory of Mind (mean value of 0.47 micro Siemens). The power of the test for bias was 0.6449. The Least Square means plot in Figure 25 shows that there is no general trend between the cultures and bias type.
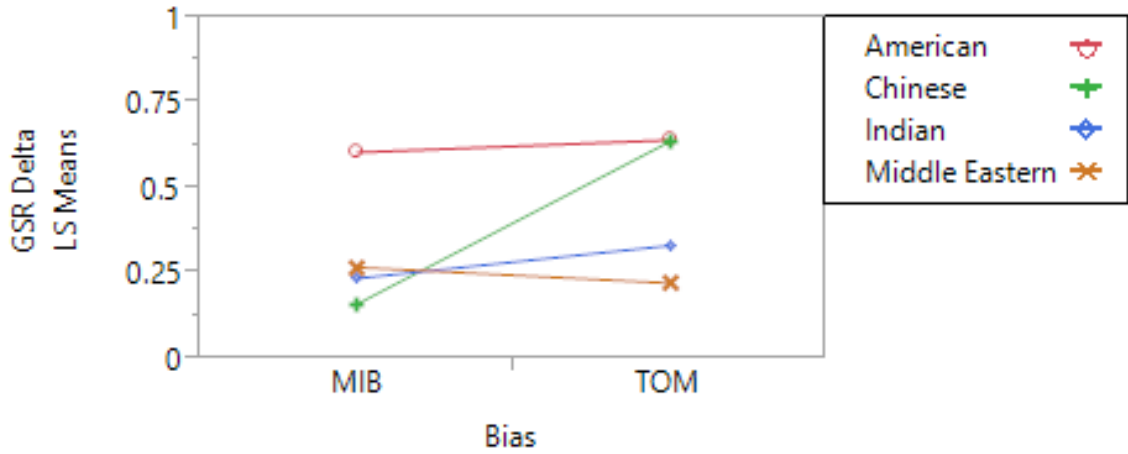
Figure 25: LS Means Plot comparing GSR for each culture according to MIB and TOM and increase in the change in GSR for all cultures except Middle Eastern. The Chinese Cultural group shows an increased change in GSR when comparing MIB and TOM.

V. DISCUSSION

When answering questions about the scenarios, Mirror Imaging Bias occurred more frequently than Theory of Mind. Mirror Imaging Bias is seen as a "shortcut" method as it requires a lower cognitive load. As stated before, the majority of individuals would answer based on their own personal experiences when they were unsure on how to act in a different culture. Others would try to recall knowledge from media such as movies and television shows which have people from that culture. Mirror Imaging Bias occurred almost twice as much as Theory of Mind for all participants. All cultures seemed to use Mirror Imaging Bias an equal amount over all the scenarios. When comparing female and male participants, both genders equally implemented Mirror Imaging Bias.

The analysis for response time showed that there was a significant difference found in the response time when comparing Mirror Imaging Bias and Theory of Mind. For all groups, Theory of Mind exhibited a greater response time than Mirror Imaging Bias by an average of 0.44 seconds. This supports how individuals take less time responding as they would naturally instead of changing their perspective to match that of the culture present. This was also consistent with findings from Salchak (2014) where individuals would spend less time answering a question from their own perspective.

When analyzing the change in pupil diameter for both the left and right eye, there was a significant difference between Mirror Imaging Bias and Theory of Mind. When there is a higher cognitive task load involved, the pupils will dilate more (Ren et al., 2012). This

support how Theory of Mind has a high change in pupil dilation than Mirror Image Bias. There was also a significant difference for the average pupil diameter changes between the different cultures. However, all cultures showed that the pupil diameter increased when Theory of Mind was used to answer questions both scenarios.

The number of fixations were found to have a significant difference between Theory of Mind and Mirror Imaging Bias. Overall, the group as a whole showed to have an average of 1.5 more fixations when utilizing Theory of Mind. Throughout the cultural groups, Theory of Mind was consistently higher in number of fixations than Mirror Imaging Bias throughout all cultural groups.

Research shows that individuals would furrow their brown during periods of concentration. This would mean that higher values for EMG Medial Frontalis would infer that a higher cognitive load is present at the time. There was no significant between the Mirror Imaging Bias and Theory of Mind. Theory of Mind did show a higher EMG reading (0.14 micro volts) than Mirror Imaging Bias (0.28 micro volts) overall as well as within each cultural group.

The measurements for the EMG Orbicularis Oculi indicate how much a person blinks while answering a question. There was no significant difference between the bias types and there was no clear trend as to which bias had a higher EMG reading in regards to culture type. When looking at the average EMG measurements overall, Theory of Mind had a higher measurement at 1.7 microvolts than Mirror Imaging Bias at 1.59 micro volts.

The GSR data increases at times when cognitive load is higher due to the response of the sympathetic nervous system. There was a significant difference between the bias

types. When looking at the different cultures, there is a clear trend for Theory of Mind producing higher GSR levels. However, the Middle Eastern group exhibited a higher GSR value for Mirror Imaging Bias. The overall measurement for GSR showed that there was a small difference of 0.08 micro Siemens between Mirror Imaging Bias and Theory of Mind with Theory of Mind yielding the higher value.

These observed metrics reinforce how when Theory of Mind is implemented, a higher cognitive load is present. Individuals must take into account how another individual would interact with a scenario which may be different from how an individual is used to acting. Most people choose to take the shortcut of using Mirror Imaging Bias. By using Mirror Imaging Bias, individuals avoid a higher cognitive load because they interact with the scenarios through their own lens. By using their own personal experiences, they eliminate taking other cultural practices into account as well as any other facts that could help make a conclusion. Since Mirror Imaging Bias naturally happens more often in all of these scenarios, it is important to find a way to ensure that individuals can learn how to implement Theory of Mind in critical situations.

CONCLUSION

"In most business situations, it is quite obvious what is right and wrong, but, admittedly, it may happen that we don't know yet what is right and wrong" (Demuijnck, 2015, p. 833).

It is natural to not be aware of other countries' customs and practices without previous research. However, it is important to keep good relations with individuals of other countries when doing business with them. Mirror Imaging Bias and Theory of Mind were

investigated to see how individuals approach different cultural situations in business settings. There are cultural biases which influence the activity of an individual to take another's perspective.

The main goals of this study were to find if Mirror Imaging Bias is an influence in making decision, to use human performance modeling to show the process of decision making, and to find is physiological measures could detect its presence.

It was found that Mirror Imaging Bias was influenced 62.45% of the time while Theory of Mind was used 37.55% of the time while viewing the different cultures in business scenarios. Out of all the metrics, the change in pupil diameter was the best indicator of measuring whether Mirror Imaging Bias occurred. Pupil diameter does not increase as much when Mirror Imaging Bias is used over Theory of Mind. While other physiological metrics showed some differences between Mirror Imaging Bias and Theory of Mind, they did not come up as significant. Other metrics could be used to test in the future to discover if there are other reliable ways to differentiate when Mirror Imaging Bias and Theory of Mind occur. It is apparent that Mirror Imaging Bias is a shortcut that individuals use while processing information.

Since international business is a common practice, the chance of Mirror Imaging Bias showing up is high. While these biases naturally occur, there are times when they are not desired. These shortcuts are used to help individuals avoid high levels of cognitive load which could hinder the completion of a task or conflict resolution. By avoiding mental workload, cognitive heuristics are used to create the influence of Mirror Imaging Bias. Figure 26 demonstrates the process of how Mirror Imaging Bias is influenced through avoiding mental workload and utilizing cognitive heuristics.
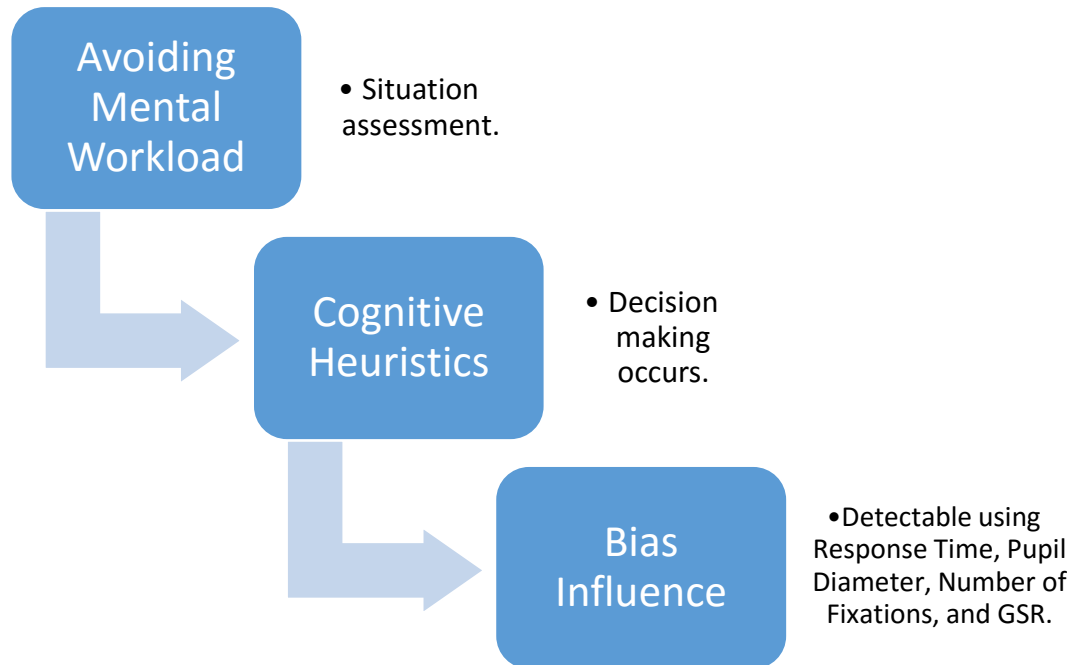
Figure 26: Process of how Mirror Image Bias in influenced. It is natural to try to avoid an increased mental workload once the situation is assessed. There are a number of heuristics that are used in order to make a decision which leads to a bias influence. The influence of MIB can then be detected by using measures such as Response Time, Pupil Diameter, Number of Fixations, and GSR.

The decision model, presented earlier in Figure 1, clearly demonstrates the process an individual goes through to make a cultural decision. This decision model either resulted in using heuristics which ultimately led to successfully using Theory of Mind or a decision influenced by Mirror Imaging Bias.

This study has found that response time, pupil diameter, number of fixations, and galvanic skin response are all reliable measurements which can be used to measure the workload of an individual and conclude when Mirror Imaging Bias is influenced.

There should be a way to indicate what knowledge is needed for certain cultures in order to avoid offending any business partners.

In order to understand when biases occur, individuals can be tested on scenarios they may encounter where there are cultural differences. The change of pupil diameter will

indicate when they can correctly use Theory of Mind. Individuals can receive a list of what customs they are unaware of in order to educate themselves.

A more accessible version of this could be an informative phone application. While modern phones do not have the ability to detect pupil diameter, they have the ability to store knowledge and references which can easily be accessed. In the future, a phone application may be used to help educate individuals of common etiquette required to interact correctly with business partners from other cultures. Individuals could select the culture that they would be interacting with and choose from different categories of social and business situations they could encounter. Under each category would be a list of actions to take in different situations which would be different from the individual's culture. Under each action, an explanation of why this is a custom would be added to help individuals better understand why this culture practices a custom. Individuals could choose to make lists of customs they feel that they may forget in order to have a quick reference from either the lock screen of a phone or from the application in order to keep a quick guide. This quick guide could then be easily accessed within a business meeting. An example of a wire frame for this cultural application can be seen in Appendix E.

In the future, this application could also be tested by having individuals answer a set of scenarios before using the application and after using the application to understand the culture they are interacting with better. A new culture can be created so no one would have previous knowledge of that culture in order to test the success of the application. Physiological metrics can distinguish when individuals try to use Theory of Mind in scenarios before and after using the application in order to test if the application serves as an effective educational device. The accuracy of their answers before and after the use of

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the application may also be compared to test its effectiveness. The influence of Mirror

Image Bias can also be detected in order to find areas to improve the application. Overall,

an application can be used in order to avoid incorrect actions from individuals in order to

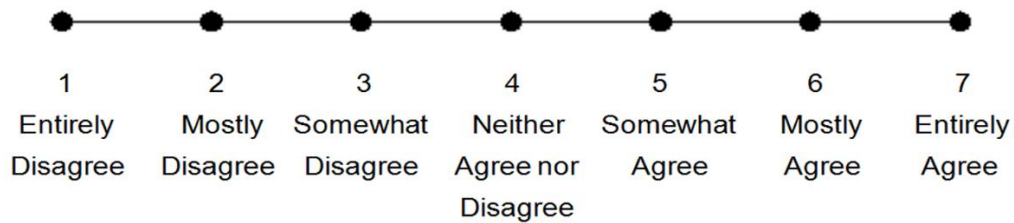keep healthy business relations with other countries.

APPENDIX A: Pre-Questionnaire

Pre-Questionnaire
Please answer the following questions. All answers will be confidential

1. What is your gender? *Please circle one:* **Male   Female**

2. What is your age? _____

3. Are you color blind? *Please circle one:* **Yes   No**

4. Do you have any type of visual impairment? *Please circle one:* **Yes   No**

5. Are you wearing corrective lenses or glasses to correct your vision? *Please circle one:* **Yes   No**

6. What nationalities do you identify with?

7. Were your parents or grandparents born in another country? *Please circle one:* **Yes   No**

8. Do you feel a close affiliation with another culture? *Please circle one:* **Yes   No**

    If yes, which and why?

9. What countries have you lived in? Please list which years you lived in the countries listed.

10. What is your primary language?

11. Are you fluent in any secondary languages? *Please circle one:* **Yes   No**

    Please list how many years you have studied your secondary languages.

12. Have you studied another culture? *Please circle one:* **Yes   No**

    Please list how many years you have studied your secondary languages.

APPENDIX B: Cultural Awareness Survey

Directions: Rate Each question using the following scale. If you are unsure about what these ratings mean, please ask the test facilitator.

1	2	3	4	5	6	7
Entirely Disagree	Mostly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Mostly Agree	Entirely Agree

1. I believe my beliefs and attitudes are influenced by my culture.

2. I think my behavior and actions are influenced by my culture.

3. I often reflect on how culture affects beliefs, attitudes, and behaviors.

4. When I have an opportunity to help someone, I offer assistance less frequently to individuals of certain cultural background.

5. I am less patient with individuals of certain cultural backgrounds.

6. I feel comfortable working with colleagues of all ethnic groups.

7. I believe people's own cultural beliefs influence their business decisions.

8. I typically feel somewhat uncomfortable when I am in the company of people from cultural or ethnic backgrounds different from my own.

9. I think business people's cultural values influence their behaviors in a business setting.

10. I feel comfortable discussing cultural issues.

11. My classroom and work experience have helped me become more comfortable interacting with people from cultures.

12. If I need more information about a client's culture, I would use resources available onsite (e.g., books, videos.)

13. If I need more information about a client's culture, I would feel comfortable asking people I work with.

14. If I need more information about a client's culture, I would feel comfortable asking the client.

15. I feel uncomfortable working with people from cultural backgrounds different from my own.

APPENDIX C: Post-Questionnaire

(Either Chinese, Indian or Middle Eastern Specified at the top of Questionnaire)

1. How familiar are you with the culture just presented?

   _____

2. How did you decide if the actions presented were correct or incorrect?

   _____

3. What knowledge did you use to make decision on how to act in each scenario?

   _____

4. Did any scenarios stand out to you in particular?

   _____

5. Did you make any assumptions when finding an answer to the question asked?
   Please circle one: **Yes   No**   If yes, what in particular stood out to you?

   _____

6. Please provide any other comments you may have about the scenarios presented
   to you about this culture.

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

Culture	Scenario	Reasoning	Question: Self	Question: Other	Correct Response	Picture
Chinese	John is meeting with the company President, Po-Sheng Yo, for the first time. Po-Sheng Yo offers him a business card which John promptly puts into his pocket for safe keeping. John continues the conversation until the meeting starts.	Read a business card carefully and then place in front of you. Leaving a business card behind is rude.	Do you find this question appropriate?	Did John act appropriately?	No	
Chinese	Dennis is giving a timeline for a project and promises an early deadline if they cut out a few features.	The Chinese would rather have product quality instead of an early due date.	Would you accept this proposition?	Will the Chinese businessman accept this proposition?	No	
Chinese	A group of Americans came to meet with a Chinese company about starting a partnership. Once seated, some of the Chinese representatives engage in small talk. Given the importance of the partnership, the Americans quickly direct the conversation to the business at hand.	Not engaging in small talk can make the Chinese feel uncomfortable.	Do you find this action appropriate?	Did the Americans act appropriately?	No	

Chinese	Mike wants to schedule a meeting with the engineers of a company since they share the same position as him to discuss a design idea. He calls the people that he wants to meet with from that company.	Although you are expected to meet with the same level as your team, you should request a meeting with the senior officials. This conveys respect.	Would you contact these people?	Did Mike contact the right people to set up the meeting?	No	
Chinese	Stephen does not speak good Chinese so he hires an interpreter to help him translate. He speaks to the interpreter to relay his message to the senior official at the meeting	The head of the group should speak towards the senior official rather than the translator to convey a sense of respect.	Do you find this action appropriate?	Did Stephen act appropriately by speaking to the interpreter to relay the message?	No	
Chinese	It is the end of the meeting. The Chinese senior official has finished with his closing statement. Joseph responds with a closing statement of gratitude. He restates the main points of the business proposal before finally concluding the meeting.	If you don't refer to the prospects of business then the Chinese will assume lack of interest.	Do you consider the conclusion thorough?	Is Joseph's conclusion thorough?	Yes	
Chinese	After proposing a new machine and its prospects, David asks the Chinese senior official for his thoughts. He states that they will do some research and come back to the idea later.	This usually means no. Chinese tend to avoid saying no and this is a way to express it.	Do the Chinese support the idea of this machine?	Do the Chinese support the idea of this machine?	No	

Chinese	Shang is asking Ted about his personal life. Ted tells him that he is married and has two children. Ted asks Shang what his yearly salary is.	Asking about salary, marital status and age is considered friendly, rather than rude.	Do you consider the question appropriate?	Is Ted's question considered appropriate?	Yes
Chinese	Andrew needs to leave the table for a moment. He does not have a chopstick rest so he sticks his chopsticks upright in a bowl of rice.	This reminds Chinese of incense which are placed at ancestors graves	Is this action acceptable?	Is the way Andrew placed his chopsticks acceptable?	No
Chinese	While in the middle of discussing a machine that the Americans are developing, the Americans propose a brainstorming session.	Chinese believe that everything that is said must be carefully chosen and find the brainstorming session immature.	Would you include the Chinese in the impromptu brainstorm session?	Is it appropriate to include the Chinese in the impromptu brainstorm session?	No
Indian	Sydney remembers reading that "dropping in" or calling in at short notice is a normal practice for Indian businesses. As a guest in India, she wants to have an initial meeting with a company's director later that afternoon.	Although appropriate in India, it is not an advisable approach for a visitor. Contact must be planned, especially for an initial meeting.	Would you find these action appropriate based on her research?	Are Sydney's actions appropriate based on her research?	No

Indian	At a business lunch with his colleagues, Robert is asked to pass a dish. As he is naturally left handed, he passes the food with his left hand.	Left hand is used for personal hygiene.	Do you find this action appropriate?	Did Robert act appropriately?	No
Indian	Cory describes a business proposition to Patel, the head of an Indian company. Patel nods his head throughout the entire conversation.	Nodding is a sign of paying attention in Northern India.	Is Patel guaranteed to accept this proposition based on his actions?	Is Patel guaranteed to accept this proposition based on his actions?	No
Indian	Priya is asking Susan about her personal life. Susan tells him that she is married and has two children. Priya asks Susan what her yearly salary is.	Asking about salary, marital status and age is considered friendly, rather than rude.	Is this question appropriate?	Is Priya's question appropriate?	Yes
Indian	Dylan brings up the topics of politics in India. He gives his opinion on a current political issue.	Talking about politics is acceptable, whereas religion is not.	Do you find this conversation appropriate?	Is Dylan's conversation appropriate?	No

|					
Indian	Ratan makes a comment that Sally's entrée looks good. Sally offers to share it but Ratan declines.	Taboo against eating from another's plate.	Do you find these actions appropriate?	Are Sally's actions appropriate?	No
Indian	Josh describes a business proposition to Rohan, the head of an Indian company. At the end of the conversation Josh asks if he will be willing to make a deal. Rohan does not say no but he also does not say yes.	Indians do not like to say "no" outright.	Would you deny or accept an idea with a clear answer?	Is Rohan likely to accept this proposition based on his actions?	No
Indian	Amanda is talking about several people in the room which he gestures to with his palm faced upward as well as directly pointing.	Pointing is considered rude. A gentle signal with the right hand with the palm face facing upward is polite when indicating a person or emphasizing a point.	Do you find these gestures acceptable?	Are these gesture considered acceptable?	No
Indian	Jordan notices that there are books still on a table and room needs to be made. He stacks the books up on the floor in a corner in order to make room quickly.	Indian's have a deep respect for books and learning	Would you take up more time to place the books in another office and risk delaying the meeting?	Should Jordan take up more time to place the books in another office and risk delaying the meeting?	Yes

Indian	At a business lunch with his colleagues, Neil orders primarily beef dishes for everyone to share.	Many Indians are vegetarian and Hindus do not eat beef	Would you order these dishes?	Did Neil order appropriate dishes?	No	
Middle Eastern	At a business lunch with his colleagues, Grant is asked to pass a dish. As he is naturally left handed, he passes the food with his left hand.	Left hand is used for personal hygiene	Do you find these actions appropriate?	Did Grant act appropriately?	No	
Middle Eastern	Abdullah is asking Frank about his personal life. Frank tells him about his hobby of painting. Frank asks Abdullah what his yearly salary is	Asking about salary is considered inappropriate in casual conversation.	Do you consider this question appropriate?	Is Frank's question considered appropriate?	Yes	
Middle Eastern	Brandon is sitting next to the president of the company. While talking he crosses his leg over his knee. Brandon continues to listen and expresses interest through nodding.	Having the sole of one's foot point towards someone is considered very rude and offensive.	Do you find these gestures inappropriate?	Are any of Brandon's gesture considered inappropriate?	Yes	

|					
Middle Eastern	Ali finished presenting their business proposition. Trevor is approving and tells Ali that they like the idea and gives him a thumbs up gesture.	Thumbs up is considered a vulgar gesture.	Would you use this gesture to indicate approval of the idea enthusiastically and appropriately?	Did Trevor indicate approval of the idea enthusiastically and appropriately?	No	
Middle Eastern	Troy is entering the building where he is about to have a meeting with the president of the company. He is chewing gum before the meeting to make sure that he has fresh breath. He asks the secretary where the office is and is seen chewing gum.	No chewing gum ever. Considered rude.	Would you chew gum in order to have fresh breath?	Is this action seen as considerate in order to have fresh breath?	No	
Middle Eastern	Walker is running late for his meeting with a Middle Eastern company. When he arrives, he apologizes and makes a comment about the traffic on his way.	Punctuality is valued but not required. A comment about traffic will get you off the hook.	Do you find being late unacceptable given his excuse?	Is Walker being late unacceptable given his excuse?	No	
Middle Eastern	Faisal has offered some refreshments at the beginning of the meeting. Drake accepts but realizes that he does not like what is served so he doesn't drink from his cup in order to avoid a look of distaste.	It is considered rude to decline a refreshment as well as not drinking from it. Drink graciously as a polite gesture.	Do you consider these actions respectful?	Are Drake's actions respectful?	No	

|						
Middle Eastern	This is the first business meeting about marketing their product so the Americans start presenting right away. They give a thorough presentation and do not miss any details.	A first meeting should avoid business and should be a social call.	Would you consider this a successful first meeting with their Middle Eastern partners?	Did the Americans have a successful first meeting with their Middle Eastern partners?	No	
Middle Eastern	At a business lunch with his colleagues, Stanley notices that there are no utensils. Since he doesn't want to eat with his hands, he asks for utensils.	Although it is acceptable to eat with hands, it is also acceptable to ask for utensils as a visitor.	Would you find these actions as rude?	Are Stanley's actions considered rude?	No	
Middle Eastern	At the end of the business meeting the American are about to leave. The Americans say goodbye to the group and wave.	You should say goodbye to each individual as a group wave is considered rude.	Would you recommend a group gesture?	Is this group gesture considered acceptable?	No	

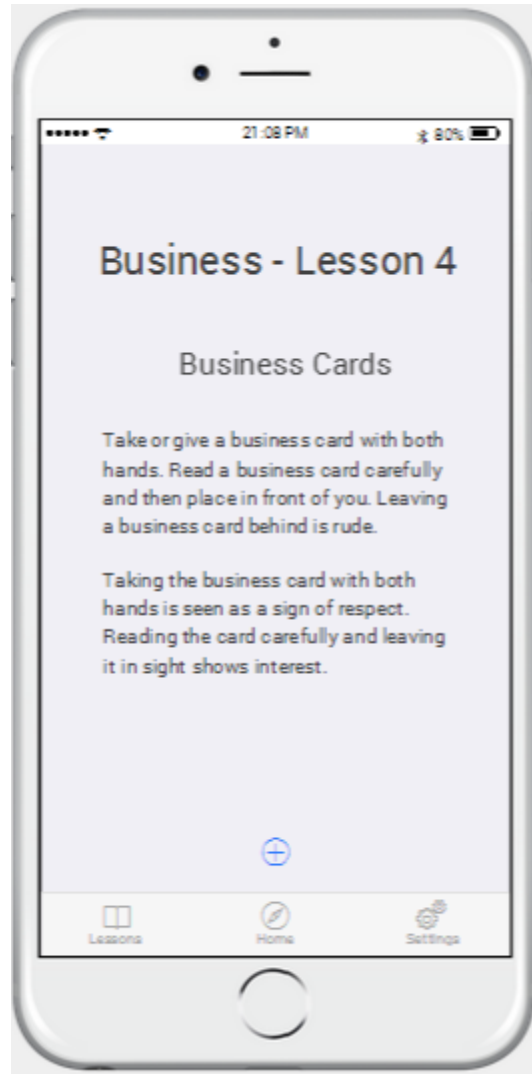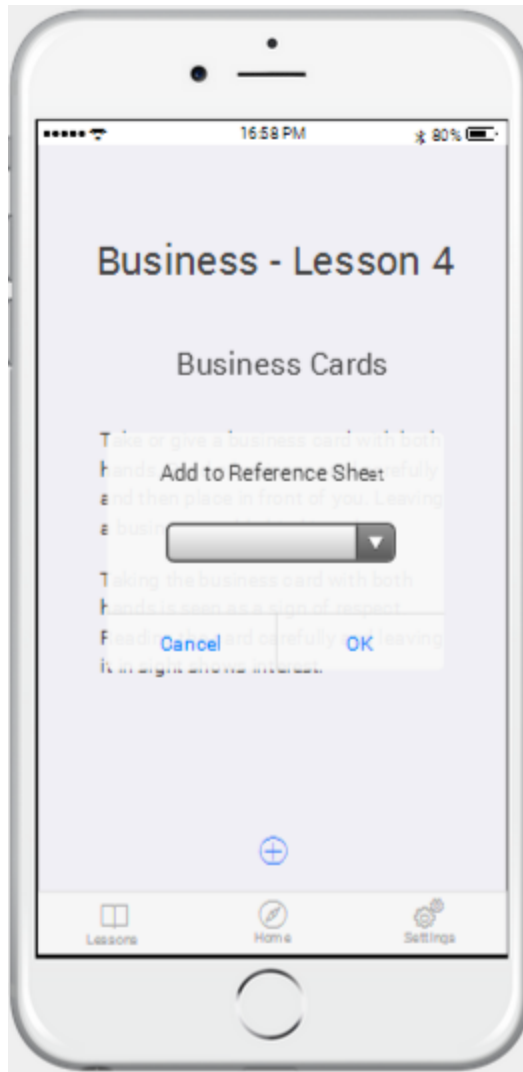APPENDIX E: Cultural Phone Application Screen Shots
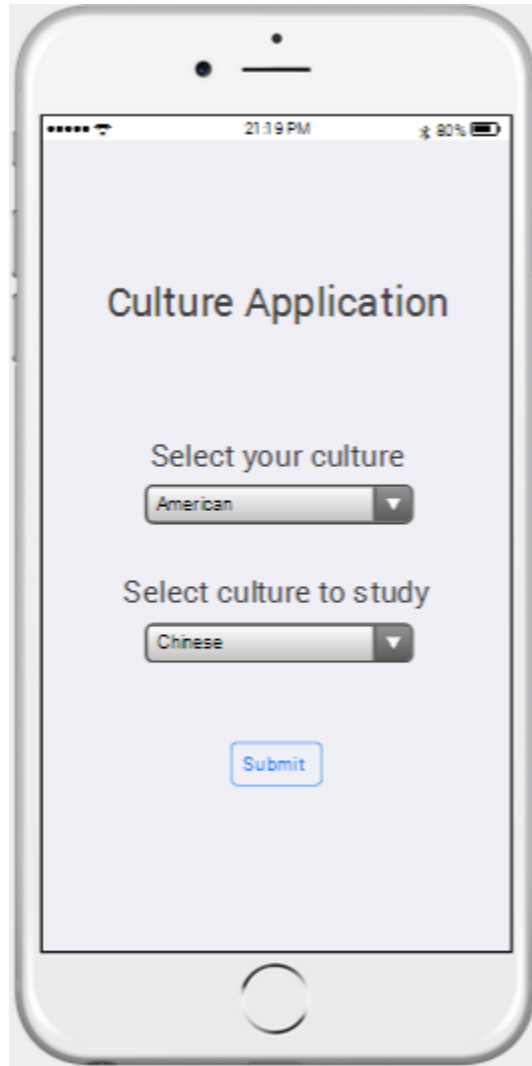
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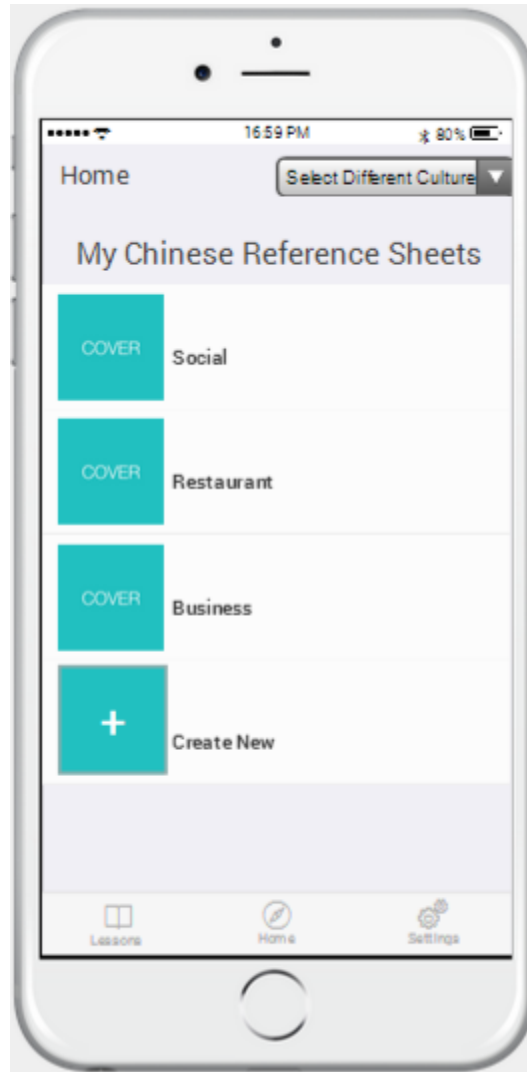
Home Page with list of Reference Sheets for that Culture.
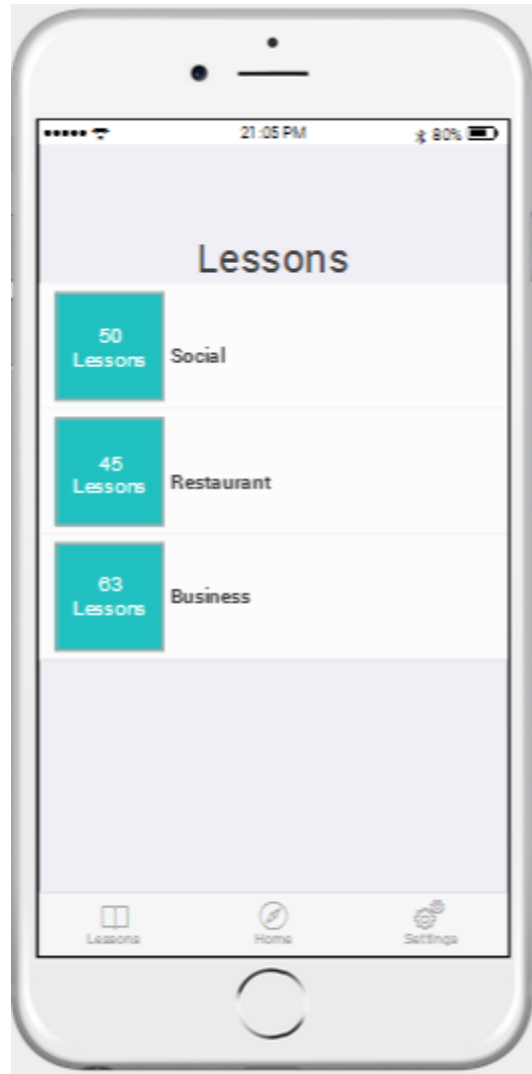
Lessons List with Different Categories

Example Lesson with proper etiquette and reason behind the etiquette.

Adding a Lesson to a Reference Sheet

Business Reference Sheet with multiple lessons added.

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