APPLYING DATA VISUALIZATION TO CULTURAL STUDY OF THE SALSA

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ABSTRACT

This research explores how data visualization can be a useful tool in the qualitative sociological research methods typically applied to studying cultural practices that involve gestures and meaningful body movement. This investigation targets salsa dance and the salsa dance community. The investigation will produce a research tool that will aid cultural anthropologists and other culture researchers interested in movement in their examinations of the complexity of the dance community surrounding the salsa. The tool will help these researchers gain better insight into the way dancers improvise new styles of a dance and the way those styles are adopted from one dancer to another. By visualizing motion data collected from salsa dancers, the investigation attempts to create a new way to study the cultural significance of gestures and movements. This technique provides a supplemental method of data collection and analysis to the traditional participant-observer method in cultural study.

THE PROMPTING FOR TECHNOLOGY IN ANTHROPOLOGICAL RESEARCH

What is data? Asking this question provides an effective way to explore how data visualization, sociological research methods and dance can come together. Merriam-Webster defines data as "facts or information used usually to calculate, analyze or plan something." Fact is in turn defined as "something that truly exists or happens" and information as "knowledge that you get about someone or something: facts or details about a subject." What these definitions provide is room for multiple ways of having knowledge about something that exists or happens. Methods of data collection vary between academic disciplines based on the phenomena they are trying to record. The physical sciences collect quantitative data taken from direct measurements of phenomena, such as the length of time a chemical reaction takes to complete or the amount of substance it produces. Anthropologists and cultural studies researchers collect quantitative as well as qualitative data. While the techniques and subjects vary, the aim to understand what is actually happening is common to both. [1]

This endeavor extends to the field of data visualization. Seeing that there is room for different types of data, quantitative and qualitative. There are also techniques in data visualization that aid different types of data as well. Cultural or social anthropology explores the development of societies and cultures. Social network graphs lend themselves well to representing connections between people in an organized manner that, structured insightfully, can reveal even more about the connections beyond their mere existence. The physical sciences, on the other hand, explore relationships between energy, physical objects and motion. Often translated into functions and relative or absolute measurements, there are various ways of using the two-dimensional plane to compare amounts or rates of change in the physical sciences. Done well, data visualization in the physical sciences can elucidate unexpected cause-effect relationships. That there are different types of data and different methods of representing each addresses the first half of the definition of data, that it is knowledge of an occurrence or existence. The second half of the definition explains the purpose of collecting data at all – to calculate, analyze or plan. Collecting data usually has a purpose beyond just collecting data. Collections of data are usually used to understand or draw conclusions about something beyond the data itself. Making a truthful connection between data and that "something beyond" sparks debate within the data visualization field about the best way to achieve it.

Practitioners and theorists in the field of data visualization disagree among themselves about what data visualization can and cannot communicate. Stefanie Posavec in her Eyeo 2013 talk discusses the spectrum within the data visualization community that ranges from objective and subjective representations of data, from the accurate and proper representation of statistics to the communication of the overall meaning and relevance of dataset. Posavec describes herself as a freelance graphic designer who specializes in data-related design. She describes the field of data visualization as having two camps: the first camp gathers data purists who require every decision within a data visualization to have a data-centric purpose and the second camp gathers those who allow subjective and emotional motivations in their design decisions. Posavec claims that in reality there is a large gray area between these groups and proposes a new practice, data illustration, to accompany data visualization and information design. She defines a data illustrator as follows.

"A data illustrator is someone who visualizes data in order to communicate something beyond what is evident in the data itself. The message the designer wants to communicate is usually more emotional and subjective than what's found in the data and often this data's secondary and used as an objective means to a subjective ends." [2]

In her data illustration work, Posavec herself has created a dance-related visualization. During her data artist residency with Facebook, Posavec used the data of a couple's interactions with each other over the course of a month and turned them into dance steps. The work references how couples perform a version of their relationship on social media that is designed for public consumption. The dance steps are imprinted in a hallway of Facebook's campus and reminiscent of illustrations in printed dance instruction books. This project exemplifies what Posavec means when she says data illustration communicates something that is not evident in the data itself. While the couple's quantitative

Facebook data could itself reveal a great deal about them, the salient aspects of relationships, how the people in them feel about each other and the overall dynamic of how they relate to each other, may be better represented as a dance than a more traditional graph. [3]

Jer Thorp is a practitioner, whose opinions on authenticity in data visualization contrast with Posavec's. He works as a data artist and has served as a past Data Artist in Residence for the *New York Times*. Thorp creates data visualizations that intersect the subjects of data, science, art and culture. [4] As a data artist, Thorp emphasizes the importance of making data more human instead of making data merely a profitable collection of information for constructing tools and conducting research. To Thorp, the personal stories that contextualize data is what gives it the meaning that makes it important to us. In his February 2014 lecture at the University of Colorado – Boulder, Jer Thorp addressed the topic of authenticity in data visualization. He recommends maintaining the truth in an visualization by discussing the data as a measurement of phenomena but not the phenomena itself. For example, if practitioners create a visualization of census data for the population of a county, the practitioners cannot say that they have represented the number of people living in that country. Rather the practitioner can honestly say that they have represented measurements of the county's population collected by United States government in a certain year using certain methods. This distinction Thorp makes is important because the facts of a data visualization begin in the method of data collection itself. What is the happening that was recorded and how was it recorded? A flaw in the United States census, for example, is that is does not account for the homeless despite their contribution to the population, a relevant fact omitted. [5]

Thorp's and Posavec's viewpoints address two important questions in visualization: what is the truth the visualization should communicate, and what are the limits to communicating that truth as accurately as possible? Both Thorp and Posavec agree that data's relevance is in a realm beyond the data itself. Thorp often cites his personal sentiment for the GPS location of where he met his significant other. The data point's value is based on the experience connected to it. GPS data can track an people's movements but not the deeper story of the motivation and significance of their travels. Data illustration for Posavec gives room for a practitioner to communicate personal viewpoints into the interpretation of a dataset. The limitations on communicating this truth are, as Thorp mentions, part of the nature of dataset and as Posavec notes in her talk, part of the design decision making of the practitioner. The subjective insights of the person creating the data visualization cannot overtake design decisions to the point that the data visualization can longer communicate the topic of the dataset. Anthropologists face the same concerns of balancing straightforward statistics with artful context when interpreting data. Anthropologist Clifford Geertz proposed an interpretative approach to anthropological research that set him apart from functionalist anthropologists such as Levi Strauss who asserted that cultural elements, such as rituals and institutions, could be understood according to the purpose they served. [1] In his book *The Interpretation of Cultures*, Clifford Geertz breaks down the significance of observing a phenomena but also infer its greater meaning. He provides examples for several different contexts and motivations for a man to rapidly and repeatedly open and close his right eye. The man could have a twitch and thus the motion has no meaning beyond indicating a physical condition. The man could also be signaling a friend in morse code through a series of winks. Or, if there are two men opening and closing their right eyes, it could be that one man is mocking the other. Phenomenally the action looks the same in all three situations but has different causes and intentions. An anthropologist observing this behavior then, according to Geertz, cannot simply recount the action. He must also recount the context and meaning of the action; he must interpret it. [7]

This discussion of what data visualization can honestly communicate is relevant to this project in that it calls into question this type of interpretation proposed by Geertz into question. Motion data collected from a person's movements can provide an objective measurement of how a person's body was positioned over time. However, that would not be the goal of collecting the data in the first place. Contextualizing those movements as having the purpose of dance and then interpreting their meaning or significance would bring purpose to the dataset. The question that stems from this is the method. Should an anthropologist use motion data to understand a gesture and its cultural meaning? Is the data that the anthropologist can effectively use limited to his direct observations and participation in a community and interpretation of those experiences? Any camera or motion tracking device will see the same phenomena as the anthropologist, but they will generate additional information in their observation that the anthropologist cannot and at a level detail the anthropologist cannot. Qualitative data will be generated from observing these physical facts regardless of the technology employed to capture evidence of this motion, so is motion data collection appropriate in anthropological research? Can anthropological research use motion data visualization to support its research? Justifications for why this may be an appropriate method come from complexity theory.

COMMUNICATING THE SALSA

Studying salsa dance and its community with the aid of digital tools continues the mediation the dance has undergone to satisfy the growth in its popularity around the world. This mediation, however, has had its own effects on the spread of the dance and its fans. The following section will discuss the effects of mediation on the spread of salsa's various styles and the social status of its dancers, precedence for motion study using camera technologies and abstraction of motion data recording to properly analyze dance movement. Viewers of the popular television show Dancing with the Stars may claim that dances such as the salsa are an art form and they would be correct in the sense that people who dance the salsa bring their creativity to it. [8] Salsa develops in, what Sheenagh Pietrobruno calls, "lived circumstances" in her book *Salsa and Its Transnational Moves*. [9] While the dance involves an artistic and expressive endeavor on the part of the individual dancers, the dancing the salsa is not in the same category as the performing arts, such as ballet or theatre, nor the fine arts, such as painting or sculpture. Dance as a human activity with cultural significance and meaning has a long history that begins with the cultural practices of primitive societies. This research examines the cultural dynamics of modern social dance, specifically the salsa. The purpose of limiting this investigation's scope to modern social dance is to understand it as a distillation of cultural identity and identity negotiation based on the interactions within a dance community of people who do not necessarily identify their dancing as an artistic practice but more so as a social activity. The investigation also aims to understand the images of the salsa mediated by modern communication technologies. As such, when tracing how this social or "folk," dance and its variations travel across its transnational community of dancers, they can be examined not only in how they flow from dancer to dancer, but also in how they flow through media channels. For the purpose of this investigation, the salsa will be examined because of its rise to international practice demonstrated by its popularity in large, urban cities across the world. [9]

Other cultural practices can provide a framework for understanding how salsa may have risen to international popularity. The process of communicating a social dance like salsa can be considered an oral art in the sense that salsa is not communicated in a written form. However, mediation of the dance has diminished its oral history qualities. Oral histories tend to have features that make it easier to hold them in memory, such as rhythm, patterns and formulaic constructions. Salsa is communicated not so much by words, but by the shared movement of dancers as they cue each other from move to move through body language. On the other hand oral traditions, similar to dance, incorporate improvisation, making each re-telling of a story a unique performance by the orator. As two dancers interact, they trade moves and styling from their respective dance cultures that their partners may accept and incorporate into their own style of dance. However, the commodification of salsa dance into dance lessons and ballroom competitions preserves salsa in a manner that diminishes its ability to continue morphing as it spreads. Mediation of the salsa through dance books, manuals, videos and graphical representations contributes to this as well. Recording salsa into a medium preserves one distinct style of the dance and usually this style is not the salsa danced in lived circumstances as a social, cultural activity. It is usually the ballroom style of salsa that is preserved in media. Preserving this style of salsa serves the economic purposes of ballroom culture. In order for judges to evaluate competitive dancers against each other, the judges need some canon of style on which to base their decisions. The commodification and mass marketing of ballroom salsa then tends to leave out the more organic style of "street" salsa or the salsa that is not inspired by the performance focus of ballroom dance culture. Salsa as it is danced in lived circumstances will still be preserved. Those who dance it as a performative means of living their cultural identity will maintain the more organic qualities that allow for creating new styles from it. However, its international image will be one adapted to and commodified by Western ballroom culture. [9]

Codification and value associated with certain styles of salsa are important because they express power struggles and social hierarchies embedded in the society surrounding the dance community. In *Salsa Crossings: Dancing Latinidad in Los Angeles,* Cindy Garcia describes the way dance partners may choose to disguise their Latin identities by adapting their dance style to the more performance-oriented, glitzy style whose image has been mass mediated by Hollywood films such as *Dirty Dancing*. Another part of the process of becoming a respected, sought after dance partner in the L.A. salsa scene is to disguise any dance movements associated with "blackness." Despite salsa's Afro-Cuban origins, black dancers and Cuban style salsa dancers, because Cubanness is conflated with blackness, are shunned and their dance style is excluded. Ballroom style salsa is positioned at the top of the style hierarchy in Los Angeles because dancers want to disassociate from ethnic identities that are devalued in U.S. society. Dancers recognize the history of discrimination aimed at African Americans in U.S. society, so they exclude dance styles associated with them to avoid the negative perceptions surrounding this group. Street salsa is associated with undocumented, Latino low-wage workers who are stereotyped as all immigrating from Mexico despite coming from all over Central America. These are just the current power struggles that are embedded in salsa. Tracing the dance back to its origin, many countries attempt to take credit for creating the salsa, though it is often attributed to Cuba. However, Pietrobruno observes that no culture has a pure origin. For example, while the salsa is traced to Afro-Cuban origin, the Spanish influences of the dance had African influences embedded in them already before interacting with the dance rhythms of African slaves. Spain's dance culture and music was influenced by the invasion of the Moors of North Africa, so the influence they brought to the dance was already that of hybridized dance culture. [10] Understanding salsa's commodification, communication and origins brings to light how its transmission is controlled. The transmission of salsa is subject not only to the limits and methods of oral communication, media and mass marketing, but also to the identity negotiation of the dancers. This investigation creates a tool that can bring this process to light by creating a visualization of movement in salsa dance. The visualization in this investigation serves as a tool for motion analysis.

VISUALIZATION DEVELOPMENT

The participant observation method is a qualitative data collection method employed within anthropology. In this method, researchers live in a foreign culture while keeping a thorough account of observations and interviews with their subjects. [11] In participant observation, researchers enter into the life of the community they examine. Data collection tools used in this process may include journal entries and audio and video recordings. Using the Microsoft Kinect for specifically motion data collection and visualization offers the advantage of a relatively inexpensive, commercially available and portable device for capturing motion data. This device has the additional benefit of providing depth sensing of motion without invasive equipment, such as reflective markers often using in more advanced motion capture systems, to collect precise motion data. Using open source software such as NI Mate and programming language libraries such as openFrameworks, developers can create applications that use motion data sensed by the Kinect. The data visualization tool built in this investigation uses the Kinect, NI Mate and openFrameworks. NI Mate is a freely available software application that allows users to read and send messages to the Kinect using the Open Sound Control or OSC, protocol. OpenFrameworks is an open source C++ library for creative coding. Before deciding to use this set up, other methods and arrangements were tested.

In its first iteration the visualization needed to simply read previously collected motion data files. At this point, the code was written in Processing using a BVH file parser and motion data available from the Perfume motion data project. Perfume is a pop band from Japan that released motion capture data of one of its performances for the public to use in creating animations and other motion graphic creations. As a newcomer to working with motion data, the first challenge in the project was understanding how motion data was translated into usable form. The most common file formats discovered were BVH files, a proprietary format from Biovision, a company that has since closed and AMC/ASF files. Carnegie Mellon University offers a large database of over 2,500 motion capture files in the latter format, but they have all been converted to BVH files. With a available sample data, the next step was what coding languages were available for working directly with motion data, not just a lifestream of motion data from a camera. After further research, the Perfume project was discovered, which provided sample motion data and a BVH parser. This was the first success: finding a file format that could be read and manipulated in a familiar programming language.

The next challenge was to understand how to manipulate the 3D motion data to create 3D graphics in Processing. Using Processing in its 3D rendering mode was new, so a great deal of time was spent reading and trying to understand the P3D tutorial. This was complicated by multiple browsers not running the Java examples referenced in the text. The breakthrough came from abandoning this slow method and just twiddling with sample code in Processing itself. The biggest adjustment was understanding how the axes in Processing are set up and the way shapes rotate. Once 3D in Processing finally clicked, development moved on to creating a 3D grid that could be used to measure movement of individual's motion data. Getting this right required working with the 3D rotations to check that the code rendered as expected. However once this was transported to the sketch running the motion data, things started to fall apart. The grid needed to be rendered at actual size, not scaled and the number of grid lines had to be reduced. Rendering the 200 grid lines at 60/sec along with the motion data slowed Processing down dramatically. The idea was to visualize each individual within a grid. At first, this simply meant translating the grid along with the sample motion data. However the way the parser works, using the parameters directly actually broke up the human form into appendages. The grid inside the sketch worked, but it needed one data point parsed out from each dancer to center itself on. A JAR file reader helped open up the BVH parser class. The BVH file would need to be read to pull out this particular point, not just play the data.

The second iteration created a method of recording the motion data. The system needed to create a file of timestamped motion data and export time-sequenced images of the motion in action. This iteration was successful in that the system created did create a text file of motion data and that the system did create a series of images of the motion captured over time. However the system sometimes created un-readable image files and the visualization itself required further development. In addition to this, the feedback of the motion data into OpenFrameworks did not visually reflect the same actions in real space. The tracked user's movement did not affect the graphics in a straightforward way like when someone sees himself in a mirror or video camera.

Several technologies were tested for this iteration (Processing, SimpleOpenNI, OpenFrameworks, ofxKinect, ofxOpenNI, Synapse and SynapseStreamer) to determine the best method for collecting data from the Kinect. This iteration revealed some of the Kinect's quirks in its motion sensing detection due to its design for home living room use and the types of motion data information it offers. The first recording used MaxMSP, a visual programming language and Synapse. MaxMSP was later substituted for text-based programming. The first test arrangement used Processing and SimpleOpenNI. OpenNI allows developers to create software for natural interface devices and SimpleOpenNI provides a wrapper for this middleware so Processing developers can create interactive projects with it. This method was abandoned after further research into the SimpleOpenNI library. The library's original creator no longer developed for it or provided support for its development community. His example programs were added to the Processing forums with a notice to the community to help each other figure the library out on their own.

Keeping in mind that the final setup will ideally be useful to anyone who intends to repeat this project, it made sense to move on to another solution. The next test used openFrameworks. OpenFrameworks had the advantage of already having an ofxKinect library integrated into its native build. This particular library, however, did not provide skeleton tracking and only allowed manipulation of the depth sensing data. Development proceeded to another library for the Kinect, ofxOpenNI, a wrapper for OpenFrameworks offered access to joint data. Extracting the Kinect's joint data from the ofxOpenNI library was unclear. Further research uncovered an application that used Synapse with OpenFrameworks. The program took advantage of a Synapse class written specifically for OpenFrameworks. This setup worked, but the limitations of Synapse would ultimately replace it with NI Mate. Using Synapse with OpenFrameworks was very similar to using it with MaxMSP. The program needed to be running before starting the application to properly collect data. The hinge was understanding how Synapse returns that data and realizing the difference between vector data, ofxVec3f and the C++ vector data type. Though the update function in openFrameworks could easily write the Synapse's data, the draw function could not use the same variables to display shapes. After debugging, the program compiled fast enough that the variables were still empty when the draw function called them. After adding some if statements and boolean controls, the program flowed in a better order. After the program flow was fixed, development proceeded to creating nodes to display all the joint data. This process revealed more about the Kinect's skeleton reading and provided feedback for openFramework's 3D space. Some flipping of the Y coordinates and mapping of the data to fit the OpenGL Window were necessary to bring the visualization into view. The application was then adjusted to save images of the visualization. The program sometimes produced corrupt PDF files and other times valid ones. The primary problem with this iteration was the poor positioning of the graphics within the openFrameworks window. Adjusting the joint position data as it comes in by mapping it to the screen had been helpful. My latest efforts have involved trying to use an OF camera to simply look at the graphics from a different perspective. After studying the 3D camera examples included with OF, the next approach was to translate the world coordinates to the dimensions of the Kinect's view. A Kinect object was created and its width and height pulled for the window dimensions. What resulted was simply a smaller version of the same problem. The visualization was still caught in the upper right quadrant of the screen. Mapping the coordinates to the Kinect dimensions after they came in from OSC did not fix this issue with the graphics. The information from the Kinect and it seems any other camera device, came into OF upside down so the common fix is to use `ofScale(1, -1, 1)` to correct this. The side effect from this scaling, however, is that the graphics for the joints of skeleton data walk off the screen. To fix `ofTranslate(x, y, z)` was used to reposition the graphics. The application was using `ofTranslate (ofGetWidth/2, ofGetHeight/2, 0)`, though and this was causing the shift to the upper right quadrant. The graphics were drawing from the repositioned (0,0) point, the center of the screen. While `ofScale(1, -1, 1)` flipped the graphics back to the correct direction, the graphics drew from (0, -height). The graphics started in the center of the screen with `ofTranslate (0, -768, 0)`.

The advanced 3D Example introduced the viewing frustum. The viewing frustum is the space captured by the camera and also the virtual space represented as basically inverted on the screen. As one gets closer to the real world camera, the Kinect, its real world frustum gets smaller. However on screen, the skeleton graphic appears to move into the wider area of the frustum as this occurs. In this iteration the graphics were centered in the screen, but the 3D illusion was not effective because real world movement did not translate to visibly large changes on screen. If the application could correctly position a camera on the scene, the user should be able to see the dimensionality of the 3D graphics rather than a very 2D looking representation.

This called for up the camera correctly to view the scene. At first the camera was set to track with the position of the user's head. As the user's head moved from side to side and up and down, the view of the scene adjusted accordingly so it seemed as if the user were looking into a room. This perspective would be useful had that been the goal of the project (to look into a room), but the camera is actually supposed to show the viewers a view of themselves. This problem with the camera placement was revealed in testing because the 3D graphics only extended slightly beyond the user in the visualization. In the 3D space created to view the 3D motion, a mistake had been made of "holding the camera." This was fixed by simply making the camera track the z-coordinate position of the user's body in the negative.

One of the next issues discovered with the tracking is the Kinect and OpenNI's behavior when too many joints go out of view. The Kinect has a minimum distance of about 6 feet for one user, 8 feet for two (although this has decreased for the XBox One sensor). Translating the real world space to the screen space revealed some potential problems. Users could "dive into" the graphics within a small distance between the Kinect and the back of the real world frustum. The graphics reacted most sensitively to the motion within this space. Advancing closer to the Kinect beyond this point caused too many joints to drop out view for OpenNI and the Kinect, so the graphics "died" at that point. The same thing happened when users backed up too far and passed beyond the "back wall" of the real world frustum. To keep the tracking going for as long as possible, tracking the z-coordinate of the user was testing on different joints. The head and feet were the worst joints because they were the first to disappear from view and also the joints with the largest range of motion. Using these two caused the visualization to move too erratically. However, using a joint such as the torso provided so much stability that the visualization didn't have enough movement. What worked best was tracking a hip joint, which had enough movement for tracking a person dancing but a small enough range of motion to keep the visualization stable enough that viewers could understand what they are seeing.

In this iteration displaying the output on a larger screen was tested to see if viewers can better connect with the size of the motion graphics in human proportions and from there dance movement. Viewing the visualization projected on a surface, however, made some adjustments apparent. The visualization would need to "stand" at the bottom on the projected surface. The two foot joints for the skeleton data would need to be at the bottom of the screen so that when projected a viewer can feel as if he or she is standing next a figure of typical human height. The visualization currently sized the skeleton so that it was near the of the frustum, so it was small and centered on the screen.

Solving this needed a few considerations. The figure could not move into the middle of the visualization as the tracked user moved backwards because that would not mimic real life. Thinking about it more it seems like the motion would only seem realistic if it remained at the "front" of the screen, that is as close as possible to the viewer without disappearing out the bounds of the screen to preserve the illusion of 3D space. The wall could be thought of a window into a space extending beyond the wall. This seemed to be the most logical interpretation for the visualization. In the final test of this iteration, the projection was accompanied to salsa music and volunteers were invited to test the tracking of the visualization by dancing or moving in front of it. Compared to its first iteration, the visualization had come to a point of providing a visually pleasing and engaging interactivity while capturing useful recordings of tracked subjects.

The major implications for the quality and accuracy of the data are related to the Kinect's infrared sensing. The Kinect's infrared sensor collects its depth data, i.e. the position of the joints and body sections along the z-axis. The challenge with this set up is that, unlike a motion capture system which uses multiple infrared cameras surrounding the subject, the infrared tracks movement from one position. If the subject stands facing the Kinect with his body flat against the x-y plane, the Kinect can track the joints easily. However, when the subject turns to the side, tracking problems begin to occur because certain joints are occluded by the body. If a subject turns around fast enough to face away from the, the Kinect may still interpret his body as facing it. Multiple infrared sensors would provide additional depth data to resolve where joints are located when they disappear from the view of another infrared sensor.

Another issue for the data concerning the Kinect's infrared sensing is the spacial range of the sensor. When a subject goes too close to or too far from the Kinect, the Kinect stops tracking her skeleton. However, this is interpreted as a pause in movement. The Kinect sends the message that the skeleton is at a stand still in whatever position the user left it. Once the Kinect detects the user's body again, the skeleton is re-aligned, though not always properly, to the body. This creates a series of false values in the data set of the subject standing in an awkward position. The Kinect does not detect when a different subject has entered the recording. One subject can leave the depth sensing space and a different subject enter it and the Kinect will assume it is the first subject returning. Because of this keeping the infrared sensors depth range clear of other subjects and bodies that can be accidentally interpreted as a person becomes more important and the recording of one subject may accidentally turn out to be the recording of multiple subjects. From these observations, what makes the Kinect advantageous as an inexpensive motion capture tool also makes it less effective as robust and accurate motion tracking tool.

A JOURNEY IN NEW POSSIBILITIES FOR RESEARCH METHODOLOGY

One outcome of this research investigation is that the data visualization serves as a form of imaginary media for cultural anthropology's research community. The imaginary media of this research investigation would be an alternative method of communicating the knowledge of cultural inquiry. In addition to a written or videotaped account of observations collected while immersed in a dance community, the tool offers a new vantage point of exploration of data collected from the particular gesture or set of movements under study. Visualizing motion data for this purpose serves as a form of imaginary media because it envisions a new method of documenting and interpreting the cultural significance of movement. While traditional ethnographic research can accomplish this, analyzing abstract motion data may reveal insights that would be overshadowed by details of manner of dress, ethnicity or body shape or undetected in the speed of the motion itself.

REFLECTION ON RESEARCH AND RECOMMENDATIONS FOR FUTURE EXPLORATIONS

The outcome of this research investigation was the creation of a motion data visualization program that exports positional joint data over time and snapshots of the visualization program as it processes incoming data. Researchers can explore a subject's movement during the recording process by adjusting camera views on the visualization. The data collected during the development of the visualization is primarily from volunteers rather than representative members of the local salsa dance community. The visualization is useful first step in determining what role digital technology can play in supporting the research methodologies of anthropologists.

The potential future outcome for this investigation is research and development of new and accurate tools to aid cultural anthropologists in their data collection for ethnographic research. The outcomes of this investigation show that inexpensive, commercially available markerless motion capture has potential for helping researchers record observations of movement, but that potential does not yet meet the fine grain precision of observation that anthropologists need in interpreting the significance of movements. The Microsoft Kinect captures data for major joints and sections of the body. Some of these joints and sections are not primarily responsible for the intricate movements of salsa dancing that create differences in style. Even in tracking the whole hand and the whole foot, the Kinect misses the minute flourishes of fingers and twisting of feet that dancers with a ballroom dance background may use to add extra glitz to their moves. Any motion capture system investigated in the continuation of this research will benefit from being more sensitive to the particular movements of salsa. Position of the individual fingers, the foot in relation to the leg and ankle and rotations of the his and shoulders are of particular interest when observing the differences between salsa dancers.

Understanding what is and is not of particular interest when observing salsa dancers is a skill I developed prior to this investigation in the real life context of a dance venue. The implication of this is that, while digital media and technologies can assist researchers in recording data about subjects, the final interpretation will rest with the researcher. One of the ideas I held at the beginning of this investigation is that abstracting the movement of dancers as a data visualization would make it easier for researchers to compare and contrast dance movement. With the physical appearance of the dancers gone, the researcher could focus solely on analyzing the dancer's moves. However, if an anthropologist should analyze culture using Clifford Geertz' interpretative approach, then motion data visualization would benefit anthropologists more if viewed in the context of the live observation. Other factors, such as style of dress, physical build, the general atmosphere of the dance venue, can offer additional insight into why a dancer is dancing as she is and possibly normalize variations within her own movement. The background an anthropologists develops in studying a community first hand makes a valuable contribution to interpreting the data.

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