Healthcare Foodservice Workers' Knowledge of Dysphagia
and
Development of a Sensory Descriptor Lexicon and Benchmarking Instrument in Formulation Testing

by

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A DISSERTATION

IN

HOSPITALITY ADMINISTRATION

Submitted to the Dissertation Committee for the
Department of Nutrition, Hospitality and Retailing at
Texas Tech University in
Partial Fulfillment of
the Requirements for
the Degree of

DOCTOR OF PHILOSOPHY

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August, 2009

ACKNOWLEDGMENTS

The author would like to thank the following individuals for all of their tutelage, ready assistance, and sound advice. First, I would like to thank Dr. Janice Boyce, my mentor and Dissertation Committee Chair, for her knowledge of my field of research, her creativity, and her loyalty over the course of my doctoral journey. Next, I am indebted to Dr. Shane Blum and Dr. Jessica Yuan, my other committee members. Dr. Blum was instrumental in the editing process, and his open-door policy allowed the dissertation process to be greatly facilitated. In addition, Dr. Yuan was a great help in selecting, analyzing, and reporting the statistical portions of this work.

I would like to thank Dr. Dee Rollins for piquing my interest in dysphagia to begin with, as well as for choosing Dr. Boyce and me as creative consultants on the dysphagia cookbook project. This project was what led me to seek out further research into the topic.

I would like to thank Heidi Hodges for all of her assistance with my data collection, as well as for her ability to go above and beyond what was expected.

Finally, I am grateful to Dr. Nelson Barber and Dr. D. Christopher Taylor for all of their assistance as I followed them through this long and complicated process.

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ABSTRACT

The purpose of this study is twofold. The first aspect is to survey current nutrition/foodservice-related healthcare professionals to determine their level of knowledge about dysphagia, and their perceptions of dysphagic patients and their needs. The second aspect of this research is to develop a lexicon of descriptors for use by a trained sensory panel in the subjective testing of formulations potentially useful for the dysphagia diet. The study would include creating a texture benchmarking instrument designed to compare tactile sensations from the participants' fingertips with the particulate content and particulate size of the sampled product on their palettes. The primary concept will be to use this instrument to demonstrate attribute descriptors and thus elicit a more accurate attribute diagnosis by which to create the lexicon.

Study 1. A data collection instrument in the form of a questionnaire was developed to obtain an idea of the perceptions and knowledge-level of diet/foodservice-related healthcare workers about dysphagia. Subjects included foodservice workers, including food preparers and food deliverers at a large healthcare facility in the Southwestern United States. A total sample size of n = 51 surveys was collected and analyzed.

Given the means from this sample group, healthcare foodservice workers are lacking in some areas of knowledge concerning dysphagia patients, and their dietary needs. Education and training seem indicated, as the number of patients suffering from some degree of dysphagia are only going to increase as the U.S. population ages.

Study 2. While objective testing can determine a product's viscosity better than can human subjects, determining particulate size and number nearly always requires sensory evaluation. Considering the similar sensitivity shared by the human palette and the human finger pad, as well as the apparent benefit of combining sensory analysis with a tactile component, it appears indicated to create sensory tests which contain a tactile benchmarking instrument to assist researchers with subjective standardization of viscosities, particulate count and size diagnosis, and overall acceptability.

Results of the pilot study bore up this perception well. However, in practice, the second study was inconclusive, and showed strange, if somewhat significant, results.

Key Words: Dysphagia, Healthcare Foodservice, Formulation Testing

CHAPTER I

INTRODUCTION

The swallowing disorder known as dysphagia, can have a wide range of underlying causes; such as stroke, Parkinson's disease, Huntington's disease, Alzheimer's disease, and other neurological problems. Trauma-induced head injuries, and cancers of the throat and mouth are also common causes (Novartis, 2001). A European study has suggested that as many as 66% of patients in long-term care, and 30% of all stroke victims, experience dysphagia to some degree. However, dysphagia is not always the result of disease or injury; swallowing difficulties can also occur in otherwise healthy elderly people simply as a result of the aging process. In Europe, as many as 45% of people over 75 suffer symptoms of dysphagia (Novartis, 2000), and there are over 15 million Americans who suffer from swallowing impairments (Stahlman, Garcia, Hakel & Chambers, 2000).

Types of dysphagia are broken down by levels of severity, with level 1 being the most severe. This study will focus on levels 1 through 3, or moderate, moderately severe, and severe dysphagia. Assessment of the dysphagic patient is important to correctly diagnose the cause of swallowing difficulty and severity level, and to subsequently design the patient's diet. Factors such as viscosity, particulate size and particulate number are crucial components to achieve appropriate swallowability. Many factors or combinations of factors can be at the root of dysphagia. For example, dysphagia to solids suggests esophageal obstruction, whereas dysphagia to liquids may indicate neuromuscular disease. Ideally, the patient will undergo a comprehensive assessment

during which all steps in the process of mastication and swallowing will be observed, and a properly swallowable diet can be prescribed (Quinn & Ryan, 2001).

The process of designing dietary formulations for dysphagic patients contains several crucial components. First, the patient must be assessed as to which level of severity their dysphagia has reached. Such an assessment is a function of locating one or more problems in the swallowing process. Swallowing is a very complicated process involving five distinct stages, and many steps per stage. There are numerous forms of assessment available today, some static, some dynamic, by which clinical researchers can analyze a given patient, and diagnose the step or steps failing in the process of bolus transport (Leopold & Kagel, 1983). For instance, non-dynamic radiograph tests are used to diagnose calcifying neck tissue in dysphagic patients suffering from Eagle's Syndrome (Murtagh, Caracciolo & Fernandez, 2001), and bolus scintigraphy is used as a non-invasive means by which to observe timing, amplitude, and graphic patterns of laryngeal muscles, whereby data is fed into a normative database for analysis (Vaiman, 2006).

Once the patient has been properly diagnosed as to level of severity, the proper diet can be designed. According to Scholten (2001), patients acquire dysphagia in many different ways, and thus may have radically different needs regarding caloric intake. In addition, McCullum (2003) defines the three primary stages of dysphagia, and how food needs to be prepared for each stage. For example, level 3 patients can eat most ordinary foodstuffs, as long as the food is not sticky or crisp, whereas level 1 patients need food blended to a "honey-like" consistency, and must thicken all liquids to avoid aspiration.

The American Diatetic Association has recently set up a task force to oversee the development of a standardized dysphagia diet. This committee has already begun work attempting to benchmark levels of viscosity in dietary solids and liquids; a controversial topic which has never been resolved. Also, the committee has discovered improper care at an institution, on the part of nurse assistants, who were far below compliance in feeding dysphagia patients. Had training and standardized formulas been in play at this hospital, the problem could have been avoided (National Dysphagia Diet Task Force, 2002).

The occurrence of dysphagia is growing as the U.S. population ages. That fairly little research has been done is something of an alarming trend. There is a need for standardization of recipe formulas, benchmarking viscosities of dietary liquids and solids, and training of food preparers at hospitals and care facilities. The symptom is found in very large populations in the U.S., as well as in Europe. Also, the fact that dysphagia has so many potential causes, i.e., Huntington's disease, Alzheimer's disease, various cancers, trauma, etc. (Stahlman, *et al*., 2000; Novartis, 2000), makes the symptom that much more of a health issue. More research is certainly called for to prepare care givers and institutions for the next twenty years.

The process of ingestion is broken down into five stages: anticipatory, preparatory, lingual, pharyngeal and esophageal. Observance of the anticipatory stage is important to isolate problematic behaviors such as aversive responses to visual or olfactory stimuli as provided by the foods. Also, at this stage an observer will note inappropriate food choices, and impulsive behavior which could lead to difficulties. The next stage, or preparatory stage, is the point when food is placed in the mouth, mastication takes place, and the bolus is collected on the tongue in preparation for transfer. The lingual stage occurs as the tongue contracts, squeezing the bolus centrally and posteriorly toward the oropharynx. The pharynx then elevates in anticipation of the bolus. The pharyngeal stage is accomplished as the larynx moves, permitting vocal cord closure, which terminates respiration, and lessens the chance of aspiration. Then, the pharyngeal muscles contract, and the bolus is transferred by peristalsis to the esophagus. Finally, during the esophageal stage, the larynx lowers to its resting position, and through peristalsis and gravity, the bolus is transported through the esophageal segments and into the stomach (Leopold & Kagel, 1983).

A thorough assessment of the entire swallowing process will serve to determine at which point the system is breaking down in a given patient. Diagnosis can be achieved by several methods, but should begin with observation of some general factors such as drooling, wheezing, “wet” voice quality, labored breathing, gurgling noise in the neck, and lack of tongue strength. Also important is to note any decreased mental status. Aside from observations, several clinical tests are available to assess a patient’s type and level of dysphagia. The most common include plain film (radiograph), barium esophagram, manometry, bolus scintigraphy, ultrasound, Flexible Endoscopic Evaluation of Swallowing (FEES), and modified barium swallow (Quinn & Ryan, 2001).

Once properly assessed, a given patient may be placed in their respective category of dysphagia severity. However, the nutritive and caloric needs vary greatly depending on causal criteria. For example, patients suffering from Huntington’s disease will require an elevated caloric intake to maintain healthy weight parameters. Conversely, a patient who acquires dysphagia due to stroke will require a similar daily caloric intake to that of a healthy person (Scholten, 2001). Also, the level of dysphagia will determine the degree to which foodstuffs must be processed prior to ingestion. Level 3 dysphagics are permitted most solid foods, with the exception of hard, sticky or crunchy foods. Level 2 patients, by comparison, are not allowed pieces over ¼" in size, and are encouraged to eat softer and moister foods that can be easily formed into a bolus. Finally, level 1 dysphagics are allowed only smooth pureed, homogenous foods with a "pudding-like," or "honey-like" texture. All thin liquids must be thickened with commercial thickeners to avoid aspiration (McCullum, 2003).

When dealing with the more severe levels of dysphagia, the primary concern becomes that of viscosity and particulate count/size. The patients' radically reduced ability for bolus transport, when combined with their increased susceptibility to aspirate thin liquid, creates a very small margin for error in target viscosity. Viscosity can be defined as a liquid's resistance to flow. Water is an example of a thin liquid, and can be measured in centipoise (cP) as having a viscosity of 1.00. Buttermilk is an example of a thick liquid, and has a viscosity of 55.0 cP (National Dysphagia Diet Task Force, 2002)

Viscosity is a controversial subject in the laboratory, and across the field of dietetics in general. Though many studies have been conducted to analyze the viscosity of dietary liquids, there has been little success at standardization. Devices that measure viscosity in cP are expensive, difficult to use, and impractical for use in institutional kitchens (Penton Media, 2005). Other, more practical devices developed to measure viscosity (line spread test, consistometer, etc.) make correlation of data between one device and another rather difficult. Currently, the National Dysphagia Diet Task Force is attempting to benchmark standards for further research (National Dysphagia Diet Task Force, 2002).

One scenario concerning the dangers of poorly trained foodservice workers was brought to light by the ADA in 2002. The event took place in a Veterans' hospital whose policies allowed for nursing assistants to thicken the dietary supplements served to dysphagia sufferers at bedside. Apparently, due to being short staffed, less than fifty percent of the served liquids were at proper viscosity levels for such patients. The ramifications here are the dangers of silent aspiration among dysphagics, or inability of less lucid patients to report esophageal pooling. These oversights can leave the patients vulnerable to pneumonia, a common cause of death among patients with dysphagia (National Dysphagia Diet Task Force, 2002).This situation would suggest that further, similar investigations are indicated, in addition to research as to general knowledge levels among food preparers in healthcare facilities.

Confounding the issue is the fact that besides viscosity, particle size and number of particles in food plays a large part in bolus formation, and the swallowability of a food type. Swallowing depends upon the ability to sense when food particles are of an appropriate size and number to bind together in preparation for bolus formation and transport (Prinz & Lucas, 1997). Image analysis research indicates that granularity must be at a very specific level before a bolus is appropriately prepared for transport (Mishallany, Woda, Labas & Peyron, 2006). With dysphagic patients, these levels are even more crucial, and thus quality testing procedures must take all of these factors into consideration.

While objective testing can determine a product's viscosity better than can human subjects (Mann & Wong, 1996), determining particulate size and number nearly always requires sensory evaluation. Research published by the *Journal of Texture Studies* defines texture as a sensory quality, as well as a multiple parameter quality. This same research describes using multiple treatments and correlations of texture in an attempt to understand the human sensory evaluation of test foods (Szczesniak, 1986). A texture benchmarking instrument can assist researchers in sensory evaluation by making tactile the descriptors required for target attribute diagnosis. Such an instrument can blend the sensory experiences of touch and mastication. Descriptors are thus more easily conveyed to the test panel, and a more accurate lexicon could be developed.

Statement of the Problem

Millions of Americans currently suffer from at least some degree of dysphagia, this number is expected to increase as the Baby Boomer generation reaches retirement age. Our nation will be populated by more elderly people than ever before, and will thus host more individuals suffering from swallowing impairment. Speech language pathologists, nutritionists, dieticians and food preparers in the healthcare industry will likely encounter an increasing number of patients in need of a dysphagia-friendly diet. It is crucial, therefore, to increase knowledge levels about dysphagia, dysphagic patients, and their dietary needs.

In addition, the future of formulation testing could be positively affected through the development of a lexicon of descriptors as to appropriate viscosities, as well as appropriate size and number of particles comprising pureed foods. Such an instrument may prove effective in assisting sensory panelists to understand and diagnose communicate information as to key attributes in food preparations.

Purpose of the Study

The purpose of this study is twofold. The first aspect is to survey current nutrition/foodservice-related healthcare professionals to determine their level of knowledge about dysphagia, and their perceptions of dysphagic patients and their needs. The second aspect of this research is to develop a lexicon of descriptors for use by a trained sensory panel in the subjective testing of formulations potentially useful for the dysphagia diet. The study would include creating a texture benchmarking instrument designed to compare tactile sensations from the participants' fingertips with the particulate content and particulate size of the sampled product on their palettes. The primary concept will be to use this instrument to demonstrate attribute descriptors and thus elicit a more accurate attribute diagnosis by which to create the lexicon.

Research Questions

The four research questions are:

RQ1.: What are the perceptions and knowledge levels among foodservice workers in the healthcare industry as to the issue of dysphagia, the needs of dysphagia patients, and the dysphagia diet?

RQ2.: Given appropriate training, can a sensory panel diagnose honey-like viscosity in pureed food as accurately as a viscometer?

RQ3.: When added to traditional sensory testing, is a texture benchmarking instrument effective in assisting panelists to diagnose appropriate particle size and particle number in pureed foods?

RQ4.: Given affordance-based education for attribute diagnosis, can a trained sensory panel provide useful contributions to a dysphagia-diet descriptor lexicon?

Model

This research is based on the theory of affordances developed by J.J. and Eleanor Gibson while working with exploratory behavior, and its role in education. The Gibsons felt that the relationship between an animal and its environment was mainly linked to adaptation in a model of reciprocity. “Perception guides action in accord with the environmental supports or impediments presented, and action in turn yields information for further guidance, resulting in a continuous perception-action cycle” (Gibson & Pick, 2000). As the animal perceives its environment, it takes the results of this perception and quantifies them as useful/non-useful, etc. The perceived qualities are then used to adapt to a new level of perception, and to then use this new knowledge to perceive more environmental elements. While Gibson was primarily concerned with infant cognitive development, many of her findings can be applied to adult education as well.

Gibson based education and learning on what she termed “affordances.” Affordances are how we are linked to our environment; how the environment “affords” us opportunities. For example, a gravel path affords better traction for walking than does an icy sidewalk. A chair affords a more comfortable place to sit than does a muddy field.

Gibson tells us that we never stop learning from affordances, and continue to do so all through adulthood; a concept she refers to as exploratory learning (Gibson, 1988). Exploratory learning is composed of three parts: perceptual, motor, and knowledge-gathering. According to Gibson (1988), the motor function is a part of active learning, such as the hand being used to examine textures. Perception of these textures allow for building upon current knowledge, and to create the knowledge of new affordances. This is the chain of learning that continues on from infancy to old age. Affordances are realized, acted upon, and finally adapted into the knowledge base; all of which creates the ability to realize and act upon new affordances.

However, affordances are only available through information that can be perceived. Gibson suggested that multi-modal learning offered more learning affordances to infants. Gibson and Schmuckler, (1989), conducted research on active learning with exploratory behavior components. These experiments suggested that by adding a tactile component to visually perceived stimulus, the learning process was enhanced. Haptic exploration, when added to visual perception, creates a bi-modal means by which subjects were able to perceive surface affordances (Gibson and Schmuckler, 1989).

Gibson builds on earlier theories by Kopp (1974) which include similar ideas that “manipulative” exploration by infants increases motor and attentional skills, and creates an increase in focus. Exploratory learning, and bi-modal perception, then, allows an individual a means by which to adapt to known affordances, perceive new affordances, and develop a process for subsequent categorization (Gibson & Pick, 2000). In turn, to build upon Gibson’s theory, sensory researchers could include a tactile component with traditional sensory testing, whereby affording a sensory panel a more stimulating experience, and potentially a more accurate means of measurement. The model would thus include an initial training to provide a baseline for viscosity and particle size/count. This would afford panelists the ability to evaluate pureed food samples using the bi-modal method combining haptic exploration with traditional sensory testing. The bi-modal measurement would subsequently afford panelists with a means by which to diagnose target attributes of the pureed food. The model could be tested by designing a set of control variables, one of which would be pureed to specifications of the dysphagia diet; the other would be prepared out of specification. Panelist response to the control variables would indicate if baseline training was effective. After exposure to the tactile instrument, and the next set of formulations, panelist response would indicate if the benchmarking instrument was a useful component of a sensory test.

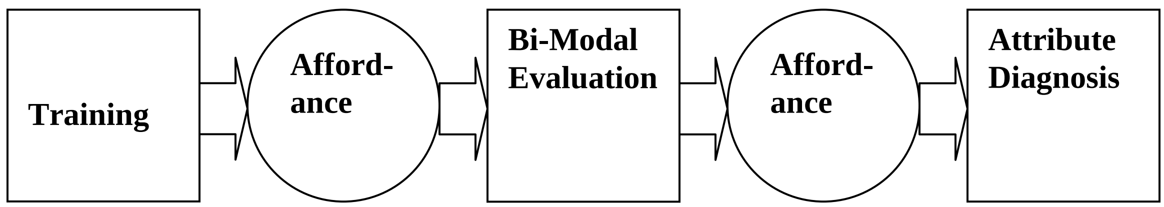

Figure 1. Model of affordance-based training and evaluation.

CHAPTER II

REVIEW OF LITERATURE

The Need for More Research

Dysphagia, a very common swallowing disorder, can be symptomatic of many varying conditions including diseases, surgical procedures, and trauma. Dysphagic patients have difficulty swallowing solid foods, but conversely will aspirate thin liquids.

Dysphagia can be caused by stroke, head trauma, cancer, Huntington's Disease, Parkinson's Disease, and simply as a consequence of aging (National Dysphagia Diet Task Force, 2002). Thirty-five percent of all nursing home residents suffer from some level of dysphagia. Twenty-seven percent of all head trauma victims present with swallowing disorders. One major concern associated with dysphagia is the problem of silent aspiration, especially in neurologically damaged patients who could not communicate with staff members. Aspiration of pureed foods, or liquids into the bronchus very frequently leads to pneumonia, and thus is considered a dangerous "silent killer" (Pardoe,1993). Dysphagia among post-stroke victims frequently leads to dehydration, calorie-deficit, airway obstruction, and death (DePippo, Holas, Reding, Mandel & Lesser, 1994). Development and testing of formulations which achieve target viscosity attributes are needed in the rapidly aging U.S. population.

The occurrence of dysphagia is growing as the U.S. population ages. That fairly little research has been done is something of an alarming trend. There is a need for standardization of recipe formulas, benchmarking viscosities of dietary liquids and solids, and training of food preparers at hospitals and care facilities. The symptom is found in very large populations in the U.S., as well as in Europe. Also, the fact that dysphagia has so many potential causes, i.e., Huntington's disease, Alzheimer's disease, various cancers, trauma, etc. (Stahlman, *et al*., 2000) (Novartis, 2000), makes the symptom that much more of a health issue.

Complications Associated with Dysphagia Patients

Dysphagia is one of the most common symptoms of Huntington's Disease. In fact, in many cases the ability to swallow is so difficult that HD patients can no longer acquire enough calories to stay alive, and can die from malnutrition. Huntington's is a basal ganglia disorder, and usually results in dementia, personality changes, and loss of motor functions. As a neurodegenerative disease, HD affects numerous parts of the brain, and causes CNS deterioration. Kagel and Leopold's study was centered around the use of videofluoroscopic swallowing studies (VFSS), by which barium-impregnated foods and liquids are swallowed by the patient, and the bolus may be tracked to diagnose the breakdown of the swallowing process. Thirty five men and women, with ages ranging from 24 to 69, were tested over the past 16 years. After each VFSS examination, the patients were rated in three stages of swallowing in order of severity. Stage 1 exhibits poor mastication skills, premature swallowing of liquids, and delayed bolus transport. Stage 2 presents as repetitive swallows, swallow delay and coughing and choking during swallow. Stage 3 is the most severe with heavy aspiration and vomiting.

Kagel and Leopold determined that compensating foodstuffs with mechanical techniques, and pureeing techniques suppressed many of these symptoms, and promoted asymptomatic swallowing. This also promoted proper bolus formation, increased mastication skills, and less aspiration of liquids. Because eating is a habitual behavior, compensation was shown to stop ingrained improper eating habits, and the techniques

were developed into a successful dysphagia diet plan utilizing the video-fluoroscopic scintigraphy (VFSS) test (Kagel & Leopold,1992).

Bakheit (2001) discusses the various complications that may arise due to neurological disorders leading to neurogenic dysphagia. This syndrome is attended by the common problems associated with any form of dysphagia, including malnutrition, dehydration, pulmonary aspiration, and deglutition apnoea. Dysphagia is caused by numerous conditions including lesions of the brain stem, cerebellum, cortex, and cranial nerves. In addition, difficulty swallowing can also be caused by several drugs administered to patients with neurological disorders.

Damage to the brain stem and cerebellum will lead to poor facial muscle control, poor lip-seal, and difficulty timing the voluntary aspects of the swallow, including the tongue-gather process to create an effectively shaped bolus.

Cortex damage most commonly leads to stroke, and dysphagia is very common among stroke victims (up to 42%). However, in 90% of cases, normal swallowing ability will be regained within a few weeks. Neither the size nor the site of cortex damage will determine the severity of the dysphagic symptoms.

Damage to cranial nerves results in a decreased ability to affect bolus transport through peristalsis of the esophagus, as well as the inability to relax the lower esophageal sphincter. This type of damage rarely causes dysphagia, but can be quite fatal due to the high risk of static boluses causing choking.

Drug interactions with body functions can cause difficulty in swallowing. Some neuroleptic drugs create sensory confusion on the tongue, which disrupts the voluntary

steps of the swallowing process. Other drugs containing dopamine can prevent proper bolus forming as well as bolus transport (Bakheit, 2001).

Viscosity and Standardization

Bakheit (2001) claims that while the ideal viscosity for foods and liquids for neurogenic dysphagics has not been determined, his own work suggests that subjective measurements can be used, and are described as syrup-like, or yogurt-like. Such low viscosity liquids present little opportunity for patients to aspirate them. However, liquids thickened too much are frequently refused by the patients. To set an objective standard for viscosity, Bakhiet has implemented a viscometer to some success.

An early attempt at setting objective viscosity standardization took place at at a rehabilitation center in Baltimore. The case study involves a care facility that adopted a standardized diet to reduce the risk of aspiration, and to improve the lives of its patients. The protocol was designed by a dietician and two speech-language pathologists, who became their own trained sensory panel. The SLPs studied the food choices for swallowability, ease of bolus formation, and ease of bolus transport. The dietitian participated in the same measurements, but also made certain of the food choices would convey the proper nutritional values. After the food choices were made, and consistencies standardized, the patients were examined with videofluoroscopic imaging, as well as bedside evaluations, to determine the viability of the various products. Finally, the entire facility's staff was educated as to proper food viscosity, proper liquid thickness, and the most obvious signs of a silently aspirating patient. After four weeks of observation, patients showed high tolerances for the menu items, low incidence of aspiration, and decreased reliance on tube feeding (Pardoe,1993).

Another attempt at standardization was described by the National Dysphagia Diet Task Force in 2002. This is considered one of the first major attempt to standardize food and liquid viscosities, and to create a working lexicon of attribute diagnostics. These lists include subjective terminology as defined by a sensory panel, as well as objective terms as determined by food and liquid measurement devices. The primary list of descriptors was consolidated into eight major criteria: Adhesiveness, cohesiveness, firmness, fracturability, hardness, springiness, viscosity, and yield stress. Once defined, these terms were correlated with various food products using the TA.XT2 Texture Analyzer, which is an industry standard device with easy to use software. The machine tested various attributes including tensile strength, compression, adhesiveness, fracture, and shear. This information was then used to design a food texture measurement scale, which allowed researchers to benchmark food textures on a scale of 0 to 100.

The task force's next project was to devise a measurement of severities of dysphagia, and to determine which viscosities of foods and liquids would be appropriate for each. The outcome was a scale of seven levels of severity, and four texture attributes: thin, nectar-like, honey-like, and spoon-thick. This information was worked into a chart for each level, whereby various food groups are listed (soups, meats, desserts, etc.), and a list of recommended food items follow, along with a list of food choices to avoid.

Finally, the task force turned to VFSS barium swallow testing to mimic the viscosities of common food and liquid choices, and to track these viscosities throughout the swallowing process. This information was used to standardize viscosity attributes in a table measured in centipose (cP), at 25 degrees Centigrade (National Dysphagia Diet Task Force, 2002).

One scenario concerning the dangers of poorly trained foodservice workers was also brought to light by the ADA in 2002. The event took place in a Veterans' hospital whose policies allowed for nursing assistants to thicken the dietary supplements served to dysphagia sufferers at bedside. Apparently, due to being short staffed, less than fifty percent of the served liquids were at proper viscosity levels for such patients. The ramifications here are the dangers of silent aspiration among dysphagics, or inability of less lucid patients to report esophageal pooling. These oversights can leave the patients vulnerable to pneumonia, a common cause of death among patients with dysphagia (National Dysphagia Diet Task Force, 2002).

One year later, McCallum (2003) described the ADA plan as less than useful in real world application. This article deals with the standardizations of liquid viscosities in a care facility which was implementing a change in protocol. In this case, the National Dysphasia Diet's "levels" of liquid viscosity was called into question due to some ambiguity on terminology. The original levels were designed by a group of dietitians, objectively measured, and broken down into 40 food textures and 18 liquid textures. However, the staff in charge of the focus hospital was worried that the term "level" would cause confusion with the food preparers and nursing staff. Also, they found the need for two extra levels which were defined as Dysphagia Pureed, and Dysphagia Mechanically Altered. In addition, there were some concerns as to perceptions on the part of the food preparers.

To address these concerns, VFSS methods were used to pin down a given patient's type and severity of dysphagia, to help with the standardization levels. The computer screens used by nurses and food preparers were also modified, with a pull-down option containing descriptions of the various viscosities appropriate for various patients. A Key Food Highlights feature was added to identify problems, and analyze the menus for necessary changes. Finally, an intensive education campaign was launched at all levels of employees, to get them familiar with viscosities appropriate to the different stages of dysphagia.

Objective Versus Subjective Testing

Viscosity is a controversial subject in the laboratory, and across the field of dietetics in general. Though many studies have been conducted to analyze the viscosity of dietary liquids, there has been little success at standardization. Devices that measure viscosity in cP are expensive, difficult to use, and impractical for use in institutional kitchens (Penton Media, 2005). Other, more practical devices developed to measure viscosity (line spread test, consistometer, etc.) make correlation of data between one device and another rather difficult. Meilgaard, Civille, & Carr, (1991) also describe sensory evaluation as very useful in product testing in the foodservice industry; however, they warn of inherent difficulties in this type of testing wherein the evaluation is not done under strict laboratory conditions. In these cases, various environmental factors can affect the sensory panelists' evaluations, and result in unwanted artifacts in the collected data.

In an effort to combine objective and subjective analysis, Mann and Wong (1996) describe a test they designed to compare the analysis of trained sensory panel members to the classic line-spread test. The function of this comparison was to develop an economical but reliable means by which hospital and long term care providers could utilize a simple objective measuring device to standardize foods and liquids for the dysphagia diet. The study was centered around some food preparation methods from a local hospital. The formulations all had been altered for viscosity levels, and were designed specifically for dysphagic patients. The sensory panel was highly trained and participated in sensory evaluations for a food research laboratory. Objective testing was done on a common line-spread instrument and timed. The results of the analysis proved a strong positive correlation between the two tests, giving the researchers the impression that even such a simple instrument can provide accurate and reliable standardization for food and beverages appropriate to the dysphagia diet.

Commercial Thickeners

A major study in the push to standardize food and liquid viscosity, Garcia, Chambers, & Molander (2005) have isolated liquid thickening as potentially the most important aspect in designing diets for dysphagic patients. Nearly 10% of residents in care facilities are prescribed thickened liquids. Of these, the viscosity levels are 60% nectar-like, 33% honey-like, and 6% spoon-thick. Speech-language pathologists (SLPs) were chosen as the focus of this study, and a survey was designed to determine which criteria they used to recommend the various viscosities, how the liquids were prepared, and how the patients seemed to accept the products. A sensory evaluation analysis expert was contacted to design the items and the instrument, which resulted in a 25-item survey to be reviewed by two 12-year veteran SLPs. The survey was hosted on a website, and was subsequently taken by 491 people.

The survey results indicated that almost 85% of respondents liked thickened liquid for dysphagic patients, and felt they were the most effective means by which to increase hydration, and decrease aspiration. The most common reasons for prescribing thickened liquids were delayed swallowing, and inability to control thin liquid (aspiration). The most common type of thickening agents used were “Thicken Up®” and “Thick It®.” The most common reasons for choosing these products were “Contract” and “I don’t know.” Perceptions as to patient acceptance of the products showed 48% of patients strongly disliked the products.

Another study by Matta, Chambers, Garcia, & Helverson, (2006) focused on these same commercially available thickening agents, and how well they altered the viscosity of six different beverages. The thickeners were “Thick & Easy®,” “Thick & Clear®,” “Thicken Up®,” and “Simply Thick®.” The first two agents are cornstarch based, with the second two based on natural gums. The six beverages to be modified were purified water, 2% milk, apple juice, orange juice, decaffeinated coffee, and Ensure Vanilla Plus.

The samples were prepared according to package instructions, and were stirred (or shaken) again just before service. A magnetic stirring device was used for consistency. Descriptors were decided upon in the panel, and eight terms were used: viscosity, graininess, slickness, starch, sour, bitter, metallic, and astringent. In addition, a base beverage was defined as a control.

The results of the test showed no appreciable performance of any single product. All products at honey-like and nectar-like consistencies tended to impart a flavor that overpowered the taste of the original beverage. Starch based thickeners created a high level of graininess, while gum based thickeners imparted a “slickness” on the palate. Gum based thickeners tended to be more consistent in viscosity levels than their cornstarch based counterparts. All thickeners at low viscosity imparted off-flavors such as metallic, sour, bitter and astringent.

A 2007 study looked at viscosity testing of commercially thickened liquids as compared with those thickened with "instant" thickening products. Three types of objective testing were utilized in the study, with the results indicating that commercially thickened liquids were more viscous than those thickened with the instant products, and were inappropriate for the dysphagia-friendly diet (Adeley & Rachal, 2007).

It is obvious that while the SLP and dietitians in hospitals and long term care facilities like the commercial thickeners for keeping patients nourished and hydrated; however, patients are less than appreciative of the fact that the flavor and consistency of thickened products can be very unappealing. One study attempted to try a different route in the pursuit of quality patient care. Nixon, (1999) describes a study whereby 40 subjects suffering from mild to moderate to severe oropharyngeal dysphagia are evaluated using a videofluoroscope and barium swallow. The subjects were given two separate barium swallows, one with the viscosity of a thin liquid, and one with the same viscosity that had been carbonated. The VFSS was used to carefully monitor the subjects' laryngeal elevations, oral transit times, pharyngeal transit times, esophageal pooling, penetration, and subsequent aspiration. This measurement found statistically significant decreased bolus formation, decreased pharyngeal transit time, and decreased incidents of aspiration. 73% of subjects who aspirated single thin liquid swallows did not aspirate single carbonated swallows. The results of the study indicate a potential trending away from the very popular commercial thickening agents toward the use of carbonated beverages. Some positive outcomes of this include ease of standardizing viscosity with carbonation, as opposed to the variability involved with commercial thickeners, the potential for improved hydration in otherwise frequently dehydrated patients, and happier patients, who in general dislike commercial thickening products.

It would appear that there are as many problems concerning standardization of viscosities as there are causes of dysphagia. In addition, the variance in methods from institution to institution confounds the issue, creating more confusion rather than less among workers in healthcare foodservice. To make matters worse, commercially available products such as the aforementioned thickeners are unappealing to patients who may refuse them; a vicious circle leading back to poor patient nutrition and hydration. This situation would suggest that further, similar investigations are indicated, in addition to research as to general knowledge levels among food preparers in healthcare facilities.

The Swallowing Process

The swallowing process takes place across five stages: anticipatory, preparatory, lingual, pharyngeal and esophageal. Observance of the anticipatory stage is important to isolate problematic behaviors such as aversive responses to visual or olfactory stimuli as provided by the foods. Also, at this stage an observer should note inappropriate food choices, and impulsive behavior which could lead to difficulties. The next stage, or preparatory stage, is the point when food is placed in the mouth, mastication takes place, and the bolus is collected on the tongue in preparation for transfer. The lingual stage occurs as the tongue contracts, squeezing the bolus centrally and posteriorly toward the oropharynx. The pharynx then elevates in anticipation of the bolus. The pharyngeal stage is accomplished as the larynx moves, permitting vocal cord closure, which terminates respiration, and lessens the chance of aspiration. Then, the pharyngeal muscles contract, and the bolus is transferred by peristalsis to the esophagus. Finally, during the esophageal stage, the larynx lowers to its resting position, and through peristalsis and gravity, the bolus is transported through the esophageal segments and into the stomach. Viscosities of foods and liquids can directly cause the breakdown of any one of these stages, or a combination of two or more stages (Leopold & Kagel, 1983). However, in addition to viscosity concerns, particle size and number of particles in food play a large part in bolus formation, and the swallowability of a food type. Swallowing depends upon the ability to sense when food particles are of an appropriate size and number to bind together in preparation for bolus formation and transport (Prinz & Lucas, 1997). Image analysis research indicates that granularity must be at a very specific level before a bolus is appropriately prepared for transport (Mishallany, Woda, Labas & Peyron, 2006). With dysphagic patients, these levels are even more crucial, and thus quality testing procedures must take all of these factors into consideration.

Sensory Evaluation of Textures

While objective testing can determine a product's viscosity better than can human subjects (Mann & Wong, 1996), determining particulate size and number nearly always requires sensory evaluation. Research published by the *Journal of Texture Studies* defines texture as a sensory quality, as well as a multiple parameter quality. This same research describes using multiple treatments and correlations of texture in an attempt to understand the human sensory evaluation of test foods (Szczesniak, 1986).

Food surface texture has been described as being a function of features that perceivable by visual and tactile senses (Chen, 2007). "By definition, texture is a sensory property" (Szczesniak, 1986), whose perception ranges across several parameters; thus sensory testing should be examined using multi-disciplinary approaches. While research is limited on using secondary tactile components with traditional sensory evaluation, there is work being done by which to study the tactile “hand-feel” of foods. Early studies involved evaluating liquid dairy products based on their hand-feel (Kapsalis & Moskowitz, 1978). Chen (2007), describes studies in which food products were analyzed by sensory panelists who not only masticated the food, but also manipulated it with their hands. This research stemmed from textile evaluation, but used similar descriptors in the food experiment, including force to compress, resilience, stiffness, geometrical properties, fuzziness, and grittiness. Chen goes on to explain how the human mouth and the human hand are able to distinguish particles of very small size. The human mouth is sensitive enough to discriminate particles as small as 5 to 25 micrometers (μm). A study by Hollins and Risner (2000) suggests that the skin of the finger, if moved across sandpaper, can sense particles as small as 9 μm.

Depending on particulate qualities of shape and hardness, sensory panelists can detect particles in foods at sizes less than 22 μm. Hard, irregular particles are easier to detect; whereas soft, round particles cannot be detected under the size of 80 μm. (Chen, 2007). Considering the similar sensitivity shared by the human palette and the human finger pad, as well as the apparent benefit of combining sensory analysis with a tactile component, it appears indicated to create sensory tests which contain a tactile benchmarking instrument to assist researchers with subjective standardization of viscosities, particulate count and size diagnosis, and overall acceptability. In turn, such an instrument could be useful in further development of a descriptor lexicon as created by the ADA. Many facets of the food and beverage industry employ standardized lexicons for such variables as mouth-feel, or other sensory descriptors (Meilgaard, M.,. Dalgliesh, C., & Clapperton, 1979). A texture benchmarking instrument can assist researchers in sensory evaluation by making tactile the descriptors required for target attribute diagnosis. The instrument can blend the sensory experiences of touch and mastication. Descriptors are thus more easily conveyed to the test panel, and a more accurate lexicon could be developed.

Given the previous work done with sandpaper by Hollins and Risner, as well as the positive experience with the pilot study included below, the benchmarking instrument should be constructed of varying grades of this material. The logic here is that sandpaper is manufactured to very exact specifications, and is measured by the µm. The finest grit discernible by the human hand would be Coated Abrasives Manufacturer's Institute (CAMI) grade 1200. This coated abrasive is composed of particles that are 6.5 µm in diameter (0.00026 inch) (Sizes Inc., 2000). Data could be collected at the interval/ratio level with such an instrument provided that there was a "zero" component. An interval scale is defined as consisting of ordered categories with intervals of exactly the same size. A ratio scale is defined as an interval scale containing an absolute zero value (Gravetter & Wallnau, 2007). As sandpaper is manufactured to such rigorous specifications, interval sizes are conceivable, as grade P80 (200 µm) is exactly twice as large as is grade P150 (100 µm). To create the zero component of the instrument, a square of waxed paper would be added, thus containing no grit.

Well-defined measurements of the sensory properties of foods will contribute to creation of good predictors of reaching target specification (Kapsalis & Moskowitz, 1978). Despite the convoluted history of designing the dysphagia diet, and the attempts at standardization involved, recent work combining multiple sensory techniques may pave the way for a solid standardization at hospitals and long term care facilities by which foodservice workers can be educated. Creation of a descriptor lexicon through the use of benchmarking sensory panelists is crucial to the industry. Well-defined attribute diagnosis is key to understanding how sensory panelists perceive and learn. Blending techniques during sensory testing could provide a richer experience for the panelists, as well as a higher degree of accuracy in determining viscosity, particle count and particle size. Such research could assist in industry-wide standardizations, as well as creating better quality products less likely to be rejected by the patients, thus affording a higher quality of life.

CHAPTER III

KNOWLEDGE LEVELS OF HEALTHCARE PROFESSIONALS

INTRODUCTION

The swallowing disorder known as dysphagia, can have a wide range of underlying causes; such as stroke, Parkinson's Disease, Huntington's Disease, Alzheimer's Disease, and other neurological problems. Trauma-induced head injuries, and cancers of the throat and mouth are also common causes (Novartis, 2001). A European study has suggested that as many as 66% of patients in long-term care, and 30% of all stroke victims, experience dysphagia to some degree. However, dysphagia is not always the result of disease or injury; swallowing difficulties can also occur in otherwise healthy elderly people simply as a result of the aging process. In Europe, as many as 45% of people over 75 suffer symptoms of dysphagia (Novartis, 2000), and there are over 15 million Americans who suffer from swallowing impairments (Stahlman, Garcia, Hakel & Chambers, 2000).

Types of dysphagia are broken down by levels of severity, with level 1 being the most severe. This study will focus on levels 3 through 1, or moderate, moderately severe, and severe dysphagia. Assessment of the dysphagic patient is important to correctly diagnose the cause of swallowing difficulty and severity level, and to subsequently design the patient's diet. Factors such as viscosity, particulate size and particulate number are crucial components to achieve appropriate swallowability. Many factors or combinations of factors can be at the root of dysphagia. For example, dysphagia to solids suggests esophageal obstruction, whereas dysphagia to liquids may indicate neuromuscular disease. Ideally, the patient will undergo a comprehensive assessment

during which all steps in the process of mastication and swallowing will be observed, and a properly swallowable diet can be prescribed (Quinn & Ryan, 2001).

The occurrence of dysphagia is growing as the U.S. population ages. That fairly little research has been done is something of an alarming trend. There is a need for standardization of recipe formulas, benchmarking viscosities of dietary liquids and solids, and training of food preparers at hospitals and care facilities. The symptom is found in very large populations in the U.S., as well as in Europe. Also, the fact that dysphagia has so many potential causes, i.e., Huntington's Disease, Alzheimer's Disease, various cancers, trauma, etc. (Stahlman, *et al*., 2000; Novartis, 2000), makes the symptom that much more of a health issue. More research is certainly called for to prepare care givers and institutions for the next twenty years.

One scenario concerning the dangers of poorly trained foodservice workers was brought to light by the ADA in 2002. The event took place in a Veterans' hospital whose policies allowed for nursing assistants to thicken the dietary supplements served to dysphagia sufferers at bedside. Apparently, due to being short staffed, less than fifty percent of the served liquids were at proper viscosity levels for such patients. The ramifications here are the dangers of silent aspiration among dysphagics, or inability of less lucid patients to report esophageal pooling. These oversights can leave the patients vulnerable to pneumonia, a common cause of death among patients with dysphagia (National Dysphagia Diet Task Force, 2002).This situation would suggest that further, similar investigations are indicated, in addition to research as to general knowledge levels among food preparers in healthcare facilities.

Statement of the Problem

Millions of Americans currently suffer from at least some degree of dysphagia. This number is expected to increase as the Baby Boomer generation reaches retirement age. Our nation will be populated by more elderly people than ever before, and will thus host more individuals suffering from swallowing impairment. Speech language pathologists, nutritionists, dieticians and food preparers in the healthcare industry will likely encounter an increasing number of patients in need of a dysphagia-friendly diet. It is crucial, therefore, to increase knowledge levels about dysphagia, dysphagic patients, and their dietary needs.

Purpose of the Study

The purpose of this study was to survey current nutrition/foodservice-related healthcare professionals to determine their level of knowledge about dysphagia, and their perceptions of dysphagic patients and their needs.

Research Question

RQ1: What are the perceptions and knowledge levels among foodservice workers in the healthcare industry as to the issue of dysphagia, the needs of dysphagia patients, and the dysphagia diet?

REVIEW OF LITERATURE

The Need for More Research

Dysphagia, a very common swallowing disorder, can be symptomatic of many varying conditions including diseases, surgical procedures, and trauma. Dysphagic patients have difficulty swallowing solid foods, but conversely will aspirate thin liquids.

Dysphagia can be caused by stroke, head trauma, cancer, Huntington's Disease, Parkinson's Disease, and simply as a consequence of aging (National Dysphagia Diet Task Force, 2002). Thirty-five percent of all nursing home residents suffer from some level of dysphagia. Twenty-seven percent of all head trauma victims present with swallowing disorders. One major concern associated with dysphagia is the problem of silent aspiration, especially in neurologically damaged patients who could not communicate with staff members. Aspiration of pureed foods, or liquids into the bronchus very frequently leads to pneumonia, and thus is considered a dangerous "silent killer" (Pardoe,1993). Dysphagia among post-stroke victims frequently leads to dehydration, calorie-deficit, airway obstruction, and death (DePippo, Holas, Reding, Mandel & Lesser, 1994). Development and testing of formulations which achieve target viscosity attributes are needed in the rapidly aging U.S. population.

The occurrence of dysphagia is growing as the U.S. population ages. That fairly little research has been done is something of an alarming trend. There is a need for standardization of recipe formulas, benchmarking viscosities of dietary liquids and solids, and training of food preparers at hospitals and care facilities. The symptom is found in very large populations in the U.S., as well as in Europe. Also, the fact that dysphagia has so many potential causes, i.e., Huntington's Disease, Alzheimer's Disease, various cancers, trauma, etc. (Stahlman, *et al*., 2000) (Novartis, 2000), makes the symptom that much more of a health issue.

Complications Associated with Dysphagia Patients

Dysphagia is one of the most common symptoms of Huntington's Disease. In fact, in many cases the ability to swallow is so difficult that HD patients can no longer acquire enough calories to stay alive, and can die from malnutrition. Huntington's is a basal ganglia disorder, and usually results in dementia, personality changes, and loss of motor functions. As a neurodegenerative disease, HD affects numerous parts of the brain, and causes CNS deterioration. Kagel and Leopold's study was centered around the use of videofluoroscopic swallowing studies (VFSS), by which barium-impregnated foods and liquids are swallowed by the patient, and the bolus may be tracked to diagnose the breakdown of the swallowing process. Thirty five men and women, with ages ranging from 24 to 69, were tested over the past 16 years. After each VFSS examination, the patients were rated in three stages of swallowing in order of severity. Stage 1 exhibits poor mastication skills, premature swallowing of liquids, and delayed bolus transport. Stage 2 presents as repetitive swallows, swallow delay and coughing and choking during swallow. Stage 3 is the most severe with heavy aspiration and vomiting.

Kagel and Leopold determined that compensating foodstuffs with mechanical techniques, and pureeing techniques suppressed many of these symptoms, and promoted asymptomatic swallowing. This also promoted proper bolus formation, increased mastication skills, and less aspiration of liquids. Because eating is a habitual behavior, compensation was shown to stop ingrained improper eating habits, and the techniques

were developed into a successful dysphagia diet plan utilizing the video-fluoroscopic scintigraphy (VFSS) test (Kagel & Leopold,1992).

Bakheit (2001) discusses the various complications that may arise due to neurological disorders leading to neurogenic dysphagia. This syndrome is attended by the common problems associated with any form of dysphagia, including malnutrition, dehydration, pulmonary aspiration, and deglutition apnoea. Dysphagia is caused by numerous conditions including lesions of the brain stem, cerebellum, cortex, and cranial nerves. In addition, difficulty swallowing can also be caused by several drugs administered to patients with neurological disorders.

Damage to the brain stem and cerebellum will lead to poor facial muscle control, poor lip-seal, and difficulty timing the voluntary aspects of the swallow, including the tongue-gather process to create an effectively shaped bolus.

Cortex damage most commonly leads to stroke, and dysphagia is very common among stroke victims (up to 42%). However, in 90% of cases, normal swallowing ability will be regained within a few weeks. Neither the size nor the site of cortex damage will determine the severity of the dysphagic symptoms.

Damage to cranial nerves results in a decreased ability to affect bolus transport through peristalsis of the esophagus, as well as the inability to relax the lower esophageal sphincter. This type of damage rarely causes dysphagia, but can be quite fatal due to the high risk of static boluses causing choking.

Drug interactions with body functions can cause difficulty in swallowing. Some neuroleptic drugs create sensory confusion on the tongue, which disrupts the voluntary

steps of the swallowing process. Other drugs containing dopamine can prevent proper bolus forming as well as bolus transport (Bakheit, 2001).

The American Diatetic Association has recently set up a task force to oversee the development of a standardized dysphagia diet. This committee has already begun work attempting to benchmark levels of viscosity in dietary solids and liquids; a controversial topic which has never been resolved. Also, the committee has discovered improper care at an institution, on the part of nurse assistants, who were far below compliance in feeding dysphagia patients. Had training and standardized formulas been in play at this hospital, the problem could have been avoided (National Dysphagia Diet Task Force, 2002).

The task force's next project was to devise a measurement of severities of dysphagia, and to determine which viscosities of foods and liquids would be appropriate for each. The outcome was a scale of seven levels of severity, and four texture attributes: thin, nectar-like, honey-like, and spoon-thick. This information was worked into a chart for each level, whereby various food groups are listed (soups, meats, desserts, etc.), and a list of recommended food items follow, along with a list of food choices to avoid.

One scenario concerning the dangers of poorly trained foodservice workers was also brought to light by the ADA in 2002. The event took place in a Veterans' hospital whose policies allowed for nursing assistants to thicken the dietary supplements served to dysphagia sufferers at bedside. Apparently, due to being short staffed, less than fifty percent of the served liquids were at proper viscosity levels for such patients. The ramifications here are the dangers of silent aspiration among dysphagics, or inability of less lucid patients to report esophageal pooling. These oversights can leave the patients vulnerable to pneumonia, a common cause of death among patients with dysphagia (National Dysphagia Diet Task Force, 2002).

One year later, McCallum (2003) described the ADA plan as less than useful in real world application. This article deals with the standardizations of liquid viscosities in a care facility which was implementing a change in protocol. In this case, the National Dysphasia Diet's "levels" of liquid viscosity was called into question due to some ambiguity on terminology. The original levels were designed by a group of dietitians, objectively measured, and broken down into 40 food textures and 18 liquid textures. However, the staff in charge of the focus hospital was worried that the term "level" would cause confusion with the food preparers and nursing staff. Also, they found the need for two extra levels which were defined as Dysphagia Pureed, and Dysphagia Mechanically Altered. In addition, there were some concerns as to perceptions on the part of the food preparers.

To address these concerns, VFSS methods were used to pin down a given patient's type and severity of dysphagia, to help with the standardization levels. The computer screens used by nurses and food preparers were also modified, with a pull-down option containing descriptions of the various viscosities appropriate for various patients. A Key Food Highlights feature was added to identify problems, and analyze the menus for necessary changes. Finally, an intensive education campaign was launched at all levels of employees, to familiarize them with viscosities appropriate to the different stages of dysphagia.

METHODOLOGY

The purpose of this study was to survey current nutrition/foodservice-related healthcare workers to determine their level of knowledge about dysphagia, and their perceptions of dysphagic patients and their needs. Subjects were foodservice workers, including food preparers and food deliverers at a large healthcare facility in the Southwestern United States. The traditional paper survey was administered by management of the abovementioned facility.

A data collection instrument in the form of a questionnaire was developed to obtain an idea of the perceptions and knowledge-level of diet/foodservice-related healthcare workers about dysphagia, dysphagic patients, and their dietary needs. The survey questionnaire was made available to participants during a monthly employee meeting. Management of the foodservice department administered the instrument to staff and assistants, and asked them for their cooperation in filling out the questionnaire. The survey was non-mandatory, and anonymous. Participants were instructed that they could choose not to participate in the survey, and, once begun, could cease to participate at any time. Participants were informed that the survey would take five to ten minutes to complete. The researcher’s contact information was provided to all participants at the end of the survey. The subjects were not compensated.

Demographic information was collected, including participants’ age, ethnic identification, and level of education. All other information pertained directly to participants’ knowledge levels and perceptions about dysphagia. All participants were entirely anonymous, thus the researcher anticipated no adverse events or liability associated with this survey.

Data Collection Instrument

This study utilized a traditional paper survey to obtain the sample data. The survey method was chosen to elicit responses directly from a sample of foodservice workers who are currently employed in the healthcare foodservice industry. Configuration of the instrument was based on a study conducted by the American Dietetics Association. That particular study employed pre- and post-training tests which utilized a series of questions based on knowledge levels of the healthcare professionals as to the dietary requirements of dysphagic patients, as well as questions designed to elicit general knowledge about dysphagia and the dangers associated with the symptom. A registered dietitian and nutritionist was consulted in the formation of the survey questions and approved their content. The instrument consisted of twenty-one questions including three on age, ethnicity and education. The instrument was designed to measure familiarity with terminology associated with treatment of dysphagic patients, general knowledge about the symptom and its causes, and knowledge as to the dangers associated with dysphagia. Demographic questions included ethnicity in this study due to the broad range of ethnic diversity associated with the foodservice industry. Proper procedures to secure approval from the University's Internal Review Board were followed prior to the study for research using human subjects.

In the first portion of the survey, participants were asked to respond to two multiple choice questions designed to gauge respondent familiarity with dysphagia, and three multiple choice questions based on viscosity requirements for the dysphagia diet. Two questions dealt with the primary danger associated with dysphagic patients (pneumonia), and one question targeted knowledge about the common causes of dysphagia. Following these were two questions about proper techniques in assisting patients during meals, and five questions about types of food appropriate for dysphagic patients. Finally, the survey contained one question about the American Dietetics Association, followed by the demographic questions. The survey was administered in April of 2009. Please see Appendix 1 for a detailed example of the survey.

RESULTS AND FINDINGS

Descriptive Statistics

A total of 51 surveys were collected and analyzed. Descriptive statistics, including means and standard deviations were measured for each item on the data collection instrument. Please see Tables 1 and 2.

Table 1: Results on Respondents' Answers to the Questions on Dysphagia (N = 51)

#	Question	Correct		Incorrect	
		Freq.	%	Freq.	%
4	Patients with severe dysphagia require liquids to be thick.	7	14	43	86
5	Patients with sever dysphagia require solid foods to be pureed.	46	90	5	10
6	It is recommended that foods prepared for the dysphagia diet be honey-like consistency.	5	11	45	89
7	Aspiration occurs when patients are unable to swallow liquids witch then enter the lungs.	45	90	5	10
8	The primary concern about patients aspirating liquids is the potential for pneumonia.	6	12	44	88
9	Common causes of dysphagia include Huntington's disease, Alzheimer's disease, multiple sclerosis.	42	89	5	11
10	Swallowing is not facilitated when patients are in a reclining position.	10	20	38	80
11	Dysphagic patients in long-term care facilities have a significantly shorter life expectancy than do non-dysphagic patients.	30	64	17	36
12	It is dangerous to allow dysphagic patients to wash down solid foods with liquids in the swallowing process.	12	24	37	76
13	Corn flakes are an example of an unsafe food for severe dysphagics.	45	93	3	7
14	Egg-salad is an example of a safe food for severe dysphagics.	9	18	40	82
15	Thickened diet-supplement beverages are not ideal to serve dysphagic patients for all three meals.	18	36	31	64
16	When feeding a dysphagic patient, the ideal amount for a single bite is one half to one teaspoon.	29	58	21	42
17	The most important consideration when planning a dysphagic patient's diet is that the foods are high in calories.	15	29	36	71
18	In 2002, the American Dietetics Association appointed a task force to compile a report on dysphagia.	18	38	29	62

Table 2: Demographic Information on the Respondents (N = 51)

Variable	Frequency	%
Age		
18-21	5	10
22-25	8	16
26-30	5	10
31-35	8	16
36-40	4	8
41-45	6	12
46-50	4	8
51-60	7	14
61 or over	3	6
Education		
High-school	31	61
Some College	16	31
Bachelor's degree	2	4
Master's degree	0	0
Doctoral degree	0	0
Ethnic Group		
Asian	1	2
African-America	10	20
Hispanic	27	53
Native-American	0	0
Middle-Eastern	0	0
Caucasian	11	22
Other	2	4

The questions concerning actual knowledge about dysphagia patients and their dietary needs (questions 4 through 18) were analyzed to determine the sample group's knowledge levels as a whole. Valid responses of n = 40 were analyzed with descriptive statistics. Data analysis revealed that the fewest number of correct responses to a question was 5, while the maximum number of correct responses to a question was 11. The mean of correct scores was 6.80, with a standard deviation of 1.52.

DISCUSSION

Given the means from this sample group, healthcare foodservice workers are lacking in some areas of knowledge concerning dysphagia patients, and their dietary needs. Education and training seem indicated, as the number of patients suffering from some degree of dysphagia are only going to increase as the U.S. population ages. As mentioned in the Veteran's Hospital scenario above, some foodservice workers in the healthcare industry are far below compliance in meeting the strict tolerance levels necessary for dysphagia patients. Poor levels of knowledge, and mistaken perceptions about dysphagia serve only to fuel this non-compliance. More training, especially among lower level workers, could raise these knowledge levels, and increase quality of life for patients.

The results of the questionnaire show several major areas in which the foodservice workers were lacking in knowledge, as well as misperceptions as to appropriate practices concerning dysphagia patients. The most alarming knowledge deficits were associated with the question about aspiration leading to pneumonia, and the water-consistency purees for level one patients. Aspiration of liquids is the primary cause of pneumonia in dysphagic patients, and frequently leads to patient death. Because dysphagic individuals are frequently dehydrated and undernourished, their immune systems may become compromised, resulting in the inability to recover from pneumonia. In addition, the diseases or afflictions suffered by the patients can compromise immune systems as well, making aspiration and subsequent pneumonia that much more of a concern.

Likewise, the question as to appropriate viscosity for level one, or severe, dysphagics is equally alarming and for precisely the same reasons. All liquids with the consistency of water (thin liquids) must be first thickened to honey-like consistency to allow the impaired swallower to control it and avoid aspiration. Administering thin liquids to severe dysphagics can create a dangerous opportunity for pneumonia.

Given that nearly half of the respondents to the questionnaire reported that they work with individuals who are sixty years or older, it is very likely that the workers are coming in contact with patients suffering from some level of dysphagia. Two other concerning elements of the questionnaire results were the items regarding feeding dysphagic patients in a reclining position, and allowing patients to use thin liquids to assist in bolus transportation of thicker foods. Dysphagic patients should always be sitting in an upright position during feeding episodes. Attempting to control liquids or pureed foods in a reclining position creates an opportunity for choking as well as aspiration. That only twenty percent of respondents were aware of this fact is cause for concern, and evidence supporting more education in healthcare foodservice. Also, the perception that thin liquids assisting patients in swallowing thicker foods is false and equally dangerous as feeding patients in a reclining position. Using thin liquids to “wash down” thicker foods creates a situation in which patients can lose control of the thin liquid, thus aspirating it. Likewise, this practice could thin the pureed, solid food, allowing the pureed bolus to be aspirated or choked upon. Nearly seventy-five percent of respondents perceived this to be appropriate feeding methods for dysphagic patients.

While liquid dietary supplements thickened with commercial thickening products are popular means by which to keep dysphagic patients nourished and hydrated, using them for all three meals is a serious detriment to patients' quality of life. Ideally there would be other options including various pureed foods thinned to proper consistency. Variety is very important to assist in stimulating already diminished diets, and to increase quality of life in a demographic known for frequent depression and apathy.

Finally, less than thirty percent of respondents were aware that many dysphagia patients need a very high calorie diet to keep them well-nourished. Many of the diseases causing dysphagia impact the patients' nervous systems and musculature causing them to consume calories at an increased rate. Thus it would behoove food preparers to utilize high-lipid, high-carbohydrate ingredients to counteract this issue.

Looking at more positive results, there were very high levels of knowledge as to what aspiration was, and the many causes of dysphagia. Also, respondents seemed well aware that patients suffering from severe dysphagia need food to be pureed to assist them in swallowing. Also, most respondents identified corn flakes as a potentially harmful food type to feed to dysphagic patients, and over half of respondents knew that appropriate bite-size for dysphagic patients was between one half and one teaspoon.

Overall, while there were quite a few items correctly answered by a proponent of respondents, some of the most important aspects of dysphagia that need to be considered by healthcare foodservice workers were not properly addressed. Foodservice workers' knowledge levels and perceptions of dysphagic patients and the dysphagia diet are lacking in the surveyed sample group. As our nation ages, this could become a much more serious problem. Higher levels of education and training in healthcare foodservice is indicated.

LIMITATIONS AND FUTURE RESEARCH

The primary limitations to this research were the relatively small sample size, the fact that healthcare foodservice workers were surveyed at only one facility, and the fairly non-diverse demographics. This study would be greatly enhanced by contacting management at several large facilities representing the Northeast, Midwest, and east and west coasts of the United States. Also valuable would be measuring responses from large inner-city facilities in urban centers. In this manner, the researchers would be privy to a much broader range of data, and would be able to look at variances within and between groups. In addition, this method would increase the variability of the demographic groups being surveyed.

While perhaps lacking in some manners, this study can provide researchers with a baseline for designing future research. It certainly brings to light the fact that there are some misperceptions and a lack of specific knowledge about important aspects of treating and feeding this growing population. This study allows for a brief look into the knowledge and perceptions of those individuals currently employed in this field, many of whom interact with dysphagic patients on a daily basis. Survey results indicate that these workers could only benefit by further education and training.

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CHAPTER IV

TACTILE BENCHMARKING INSTRUMENT AND DESCRIPTOR LEXICON

INTRODUCTION

The swallowing disorder known as dysphagia, can have a wide range of underlying causes; such as stroke, Parkinson's Disease, Huntington's Disease, Alzheimer's disease, and other neurological problems. Trauma-induced head injuries, and cancers of the throat and mouth are also common causes (Novartis, 2001). A European study has suggested that as many as 66% of patients in long-term care, and 30% of all stroke victims, experience dysphagia to some degree. However, dysphagia is not always the result of disease or injury; swallowing difficulties can also occur in otherwise healthy elderly people simply as a result of the aging process. In Europe, as many as 45% of people over 75 suffer symptoms of dysphagia (Novartis, 2000), and there are over 15 million Americans who suffer from swallowing impairments (Stahlman, Garcia, Hakel & Chambers, 2000).

Types of dysphagia are broken down by levels of severity, with level 1 being the most severe. This study will focus on levels 3 through 1, or moderate, moderately severe, and severe dysphagia. Assessment of the dysphagic patient is important to correctly diagnose the cause of swallowing difficulty and severity level, and to subsequently design the patient's diet. Factors such as viscosity, particulate size and particulate number are crucial components to achieve appropriate swallowability. Many factors or combinations of factors can be at the root of dysphagia. For example, dysphagia to solids suggests esophageal obstruction, whereas dysphagia to liquids may indicate neuromuscular disease. Ideally, the patient will undergo a comprehensive assessment

during which all steps in the process of mastication and swallowing will be observed, and a properly swallowable diet can be prescribed (Quinn & Ryan, 2001).

The process of designing dietary formulations for dysphagic patients contains several crucial components. First, the patient must be assessed as to which level of severity their dysphagia has reached. Such an assessment is a function of locating one or more problems in the swallowing process. Swallowing is a very complicated process involving five distinct stages, and many steps per stage. There are numerous forms of assessment available today, some static, some dynamic, by which clinical researchers can analyze a given patient, and diagnose the step or steps failing in the process of bolus transport (Leopold & Kagel, 1983). For instance, non-dynamic radiograph tests are used to diagnose calcifying neck tissue in dysphagic patients suffering from Eagle's Syndrome (Murtagh, Caracciolo & Fernandez, 2001), and bolus scintigraphy is used as a non-invasive means by which to observe timing, amplitude, and graphic patterns of laryngeal muscles, whereby data is fed into a normative database for analysis (Vaiman, 2006).

Once the patient has been properly diagnosed as to level of severity, the proper diet can be designed. According to Scholten (2001), patients acquire dysphagia in many different ways, and thus may have radically different needs regarding caloric intake. In addition, McCullum (2003) defines the three primary stages of dysphagia, and how food needs to be prepared for each stage. For example, level 3 patients can eat most ordinary foodstuffs, as long as the food is not sticky or crisp, whereas level 1 patients need food blended to a "honey-like" consistency, and must thicken all liquids to avoid aspiration.

The American Dietetic Association has recently set up a task force to oversee the development of a standardized dysphagia diet. This committee has already begun work attempting to benchmark levels of viscosity in dietary solids and liquids; a controversial topic which has never been resolved. Also, the committee has discovered improper care at an institution, on the part of nurse assistants, who were far below compliance in feeding dysphagia patients. Had training and standardized formulas been in play at this hospital, the problem could have been avoided (National Dysphagia Diet Task Force, 2002).

The occurrence of dysphagia is growing as the U.S. population ages. That fairly little research has been done is something of an alarming trend. There is a need for standardization of recipe formulas, benchmarking viscosities of dietary liquids and solids, and training of food preparers at hospitals and care facilities. The symptom is found in very large populations in the U.S., as well as in Europe. Also, the fact that dysphagia has so many potential causes, i.e., Huntington's Disease, Alzheimer's Disease, various cancers, trauma, etc. (Stahlman, *et al*., 2000; Novartis, 2000), makes the symptom that much more of a health issue. More research is certainly called for to prepare care givers and institutions for the next twenty years.

The process of ingestion is broken down into five stages: anticipatory, preparatory, lingual, pharyngeal and esophageal. Observance of the anticipatory stage is important to isolate problematic behaviors such as aversive responses to visual or olfactory stimuli as provided by the foods. Also, at this stage an observer will note inappropriate food choices, and impulsive behavior which could lead to difficulties. The next stage, or preparatory stage, is the point when food is placed in the mouth, mastication takes place, and the bolus is collected on the tongue in preparation for transfer. The lingual stage occurs as the tongue contracts, squeezing the bolus centrally and posteriorly toward the oropharynx. The pharynx then elevates in anticipation of the bolus. The pharyngeal stage is accomplished as the larynx moves, permitting vocal cord closure, which terminates respiration, and lessens the chance of aspiration. Then, the pharyngeal muscles contract, and the bolus is transferred by peristalsis to the esophagus. Finally, during the esophageal stage, the larynx lowers to its resting position, and through peristalsis and gravity, the bolus is transported through the esophageal segments and into the stomach (Leopold & Kagel, 1983).

A thorough assessment of the entire swallowing process will serve to determine at which point the system is breaking down in a given patient. Diagnosis can be achieved by several methods, but should begin with observation of some general factors such as drooling, wheezing, "wet" voice quality, labored breathing, gurgling noise in the neck, and lack of tongue strength. Also important is to note any decreased mental status. Aside from observations, several clinical tests are available to assess a patient's type and level of dysphagia. The most common include plain film (radiograph), barium esophagram, manometry, bolus scintigraphy, ultrasound, Flexible Endoscopic Evaluation of Swallowing (FEES), and modified barium swallow (Quinn & Ryan, 2001).

Once properly assessed, a given patient may be placed in their respective category of dysphagia severity. However, the nutritive and caloric needs vary greatly depending on causal criteria. For example, patients suffering from Huntington's disease will require an elevated caloric intake to maintain healthy weight parameters. Conversely, a patient who acquires dysphagia due to stroke will require a similar daily caloric intake to that of a healthy person (Scholten, 2001). Also, the level of dysphagia will determine the degree to which foodstuffs must be processed prior to ingestion. Level 3 dysphagics are permitted most solid foods, with the exception of hard, sticky or crunchy foods. Level 2 patients, by comparison, are not allowed pieces over ¼" in size, and are encouraged to eat softer and moister foods that can be easily formed into a bolus. Finally, level 1 dysphagics are allowed only smooth pureed, homogenous foods with a "pudding-like," or "honey-like" texture. All thin liquids must be thickened with commercial thickeners to avoid aspiration (McCullum, 2003).

When dealing with the more severe levels of dysphagia, the primary concern becomes that of viscosity and particulate count/size. The patients' radically reduced ability for bolus transport, when combined with their increased susceptibility to aspirate thin liquid, creates a very small margin for error in target viscosity. Viscosity can be defined as a liquid's resistance to flow. Water is an example of a thin liquid, and can be measured in centipoise (cP) as having a viscosity of 1.00. Buttermilk is an example of a thick liquid, and has a viscosity of 55.0 cP (National Dysphagia Diet Task Force, 2002)

Viscosity is a controversial subject in the laboratory, and across the field of dietetics in general. Though many studies have been conducted to analyze the viscosity of dietary liquids, there has been little success at standardization. Devices that measure viscosity in cP are expensive, difficult to use, and impractical for use in institutional kitchens (Penton Media, 2005). Other, more practical devices developed to measure viscosity (line spread test, consistometer, etc.) make correlation of data between one device and another rather difficult. Currently, the National Dysphagia Diet Task Force is attempting to benchmark standards for further research (National Dysphagia Diet Task Force, 2002).

One scenario concerning the dangers of poorly trained foodservice workers was brought to light by the ADA in 2002. The event took place in a Veterans' hospital whose policies allowed for nursing assistants to thicken the dietary supplements served to dysphagia sufferers at bedside. Apparently, due to being short staffed, less than fifty percent of the served liquids were at proper viscosity levels for such patients. The ramifications here are the dangers of silent aspiration among dysphagics, or inability of less lucid patients to report esophageal pooling. These oversights can leave the patients vulnerable to pneumonia, a common cause of death among patients with dysphagia (National Dysphagia Diet Task Force, 2002).This situation would suggest that further, similar investigations are indicated, in addition to research as to general knowledge levels among food preparers in healthcare facilities.

Confounding the issue is the fact that beside viscosity, particle size and number of particles in food plays a large part in bolus formation, and the swallowability of a food type. Swallowing depends upon the ability to sense when food particles are of an appropriate size and number to bind together in preparation for bolus formation and transport (Prinz & Lucas, 1997). Image analysis research indicates that granularity must be at a very specific level before a bolus is appropriately prepared for transport (Mishallany, Woda, Labas & Peyron, 2006). With dysphagic patients, these levels are even more crucial, and thus quality testing procedures must take all of these factors into consideration.

While objective testing can determine a product's viscosity better than can human subjects (Mann & Wong, 1996), determining particulate size and number nearly always requires sensory evaluation. Research published by the *Journal of Texture Studies* defines texture as a sensory quality, as well as a multiple parameter quality. This same research describes using multiple treatments and correlations of texture in an attempt to understand the human sensory evaluation of test foods (Szczesniak, 1986). A texture benchmarking instrument can assist researchers in sensory evaluation by making tactile the descriptors required for target attribute diagnosis. Such an instrument can blend the sensory experiences of touch and mastication. Descriptors are thus more easily conveyed to the test panel, and a more accurate lexicon could be developed.

Statement of the Problem

Millions of Americans currently suffer from at least some degree of dysphagia, this number is expected to increase as the Baby Boomer generation reaches retirement age. Our nation will be populated by more elderly people than ever before, and will thus host more individuals suffering from swallowing impairment. Speech language pathologists, nutritionists, dieticians and food preparers in the healthcare industry will likely encounter an increasing number of patients in need of a dysphagia-friendly diet.

Purpose of the Study

The purpose of this research was to develop a lexicon of descriptors for use by a trained sensory panel in the subjective testing of formulations potentially useful for the dysphagia diet. The study included creating a texture benchmarking instrument designed to compare tactile sensations from the participants' fingertips with the particulate content and particulate size of the sampled product on their palettes. The primary concept was to use this instrument to demonstrate attribute descriptors and thus elicit a more accurate attribute diagnosis by which to create the lexicon.

Research Questions

The three research questions are:

RQ1.: Given appropriate training, can a sensory panel diagnose honey-like viscosity in pureed food as accurately as a viscometer?

RQ2.: When added to traditional sensory testing, is a texture benchmarking instrument effective in assisting panelists to diagnose appropriate particle size and particle number in pureed foods?

RQ3.: Given affordance-based education for attribute diagnosis, can a trained sensory panel provide useful contributions to a dysphagia-diet descriptor lexicon?

Model

This research is based on the theory of affordances developed by J.J. and Eleanor Gibson while working with exploratory behavior, and its role in education. The Gibsons felt that the relationship between an animal and its environment was mainly linked to adaptation in a model of reciprocity. "Perception guides action in accord with the environmental supports or impediments presented, and action in turn yields information for further guidance, resulting in a continuous perception-action cycle" (Gibson & Pick, 2000). As the animal perceives its environment, it takes the results of this perception and quantifies them as useful/non-useful, etc. The perceived qualities are then used to adapt to a new level of perception, and to then use this new knowledge to perceive more environmental elements. While Gibson was primarily concerned with infant cognitive development, many of her findings can be applied to adult education as well.

Gibson based education and learning on what she termed "affordances." Affordances are how we are linked to our environment; how the environment "affords" us opportunities. For example, a gravel path affords better traction for walking than does an icy sidewalk. A chair affords a more comfortable place to sit than does a muddy field.

Gibson tells us that we never stop learning from affordances, and continue to do so all through adulthood; a concept she refers to as exploratory learning (Gibson, 1988). Exploratory learning is composed of three parts: perceptual, motor, and knowledge-gathering. According to Gibson (1988), the motor function is a part of active learning, such as the hand being used to examine textures. Perception of these textures allow for building upon current knowledge, and to create the knowledge of new affordances. This is the chain of learning that continues on from infancy to old age. Affordances are realized, acted upon, and finally adapted into the knowledge base; all of which creates the ability to realize and act upon new affordances.

However, affordances are only available through information that can be perceived. Gibson suggested that multi-modal learning offered more learning affordances to infants. Gibson and Schmuckler, (1989), conducted research on active learning with exploratory behavior components. These experiments suggested that by adding a tactile component to visually perceived stimulus, the learning process was enhanced. Haptic exploration, when added to visual perception, creates a bi-modal means by which subjects were able to perceive surface affordances (Gibson and Schmuckler, 1989).

Gibson builds on earlier theories by Kopp (1974) which include similar ideas that "manipulative" exploration by infants increases motor and attentional skills, and creates an increase in focus. Exploratory learning, and bi-modal perception, then, allows an individual a means by which to adapt to known affordances, perceive new affordances, and develop a process for subsequent categorization (Gibson & Pick, 2000). In turn, to build upon Gibson's theory, sensory researchers could include a tactile component with traditional sensory testing, whereby affording a sensory panel a more stimulating experience, and potentially a more accurate means of measurement. The model would thus include an initial training to provide a baseline for viscosity and particle size/count. This would afford panelists the ability to evaluate pureed food samples using the bi-modal method combining haptic exploration with traditional sensory testing. The bi-modal measurement would subsequently afford panelists with a means by which to diagnose target attributes of the pureed food. In addition, the panelists' affordance to categorize new data would afford them the ability to diagnose non-target attributes, thus generating new descriptors to add to the lexicon. The model could be tested by designing a set of control variables, one of which would be pureed to specifications of the dysphagia diet; the other would be prepared out of specification. Panelist response to the control variables would indicate if baseline training was effective. After exposure to the tactile instrument, and the next set of formulations, panelist response would indicate if the benchmarking instrument was a useful component of a sensory test.

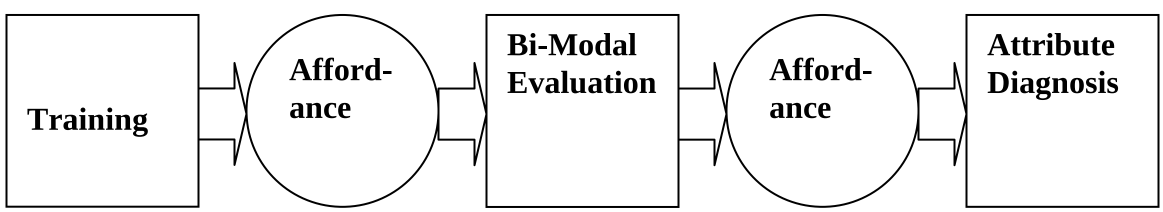

Figure 1. Model of affordance-based training and evaluation.

REVIEW OF LITERATURE

The Need for More Research

Dysphagia, a very common swallowing disorder, can be symptomatic of many varying conditions including diseases, surgical procedures, and trauma. Dysphagic patients have difficulty swallowing solid foods, but conversely will aspirate thin liquids.

Dysphagia can be caused by stroke, head trauma, cancer, Huntington's Disease, Parkinson's Disease, and simply as a consequence of aging (National Dysphagia Diet Task Force, 2002). Thirty-five percent of all nursing home residents suffer from some level of dysphagia. Twenty-seven percent of all head trauma victims present with swallowing disorders. One major concern associated with dysphagia is the problem of silent aspiration, especially in neurologically damaged patients who could not communicate with staff members. Aspiration of pureed foods, or liquids into the bronchus very frequently leads to pneumonia, and thus is considered a dangerous "silent killer" (Pardoe,1993). Dysphagia among post-stroke victims frequently leads to dehydration, calorie-deficit, airway obstruction, and death (DePippo, Holas, Reding, Mandel & Lesser, 1994). Development and testing of formulations which achieve target viscosity attributes are needed in the rapidly aging U.S. population.

The occurrence of dysphagia is growing as the U.S. population ages. That fairly little research has been done is something of an alarming trend. There is a need for standardization of recipe formulas, benchmarking viscosities of dietary liquids and solids, and training of food preparers at hospitals and care facilities. The symptom is found in very large populations in the U.S., as well as in Europe. Also, the fact that dysphagia has so many potential causes, i.e., Huntington's disease, Alzheimer's disease, various cancers, trauma, etc. (Stahlman, *et al*., 2000) (Novartis, 2000), makes the symptom that much more of a health issue.

Complications Associated with Dysphagia Patients

Dysphagia is one of the most common symptoms of Huntington's Disease. In fact, in many cases the ability to swallow is so difficult that HD patients can no longer acquire enough calories to stay alive, and can die from malnutrition. Huntington's is a basal ganglia disorder, and usually results in dementia, personality changes, and loss of motor functions. As a neurodegenerative disease, HD affects numerous parts of the brain, and causes CNS deterioration. Kagel and Leopold's study was centered around the use of videofluoroscopic swallowing studies (VFSS), by which barium-impregnated foods and liquids are swallowed by the patient, and the bolus may be tracked to diagnose the breakdown of the swallowing process. Thirty five men and women, with ages ranging from 24 to 69, were tested over the past 16 years. After each VFSS examination, the patients were rated in three stages of swallowing in order of severity. Stage 1 exhibits poor mastication skills, premature swallowing of liquids, and delayed bolus transport. Stage 2 presents as repetitive swallows, swallow delay and coughing and choking during swallow. Stage 3 is the most severe with heavy aspiration and vomiting.

Kagel and Leopold determined that compensating foodstuffs with mechanical techniques, and pureeing techniques suppressed many of these symptoms, and promoted asymptomatic swallowing. This also promoted proper bolus formation, increased mastication skills, and less aspiration of liquids. Because eating is a habitual behavior, compensation was shown to stop ingrained improper eating habits, and the techniques

were developed into a successful dysphagia diet plan utilizing the video-fluoroscopic scintigraphy (VFSS) test (Kagel & Leopold,1992).

Bakheit (2001) discusses the various complications that may arise due to neurological disorders leading to neurogenic dysphagia. This syndrome is attended by the common problems associated with any form of dysphagia, including malnutrition, dehydration, pulmonary aspiration, and deglutition apnoea. Dysphagia is caused by numerous conditions including lesions of the brain stem, cerebellum, cortex, and cranial nerves. In addition, difficulty swallowing can also be caused by several drugs administered to patients with neurological disorders.

Damage to the brain stem and cerebellum will lead to poor facial muscle control, poor lip-seal, and difficulty timing the voluntary aspects of the swallow, including the tongue-gather process to create an effectively shaped bolus.

Cortex damage most commonly leads to stroke, and dysphagia is very common among stroke victims (up to 42%). However, in 90% of cases, normal swallowing ability will be regained within a few weeks. Neither the size nor the site of cortex damage will determine the severity of the dysphagic symptoms.

Damage to cranial nerves results in a decreased ability to affect bolus transport through peristalsis of the esophagus, as well as the inability to relax the lower esophageal sphincter. This type of damage rarely causes dysphagia, but can be quite fatal due to the high risk of static boluses causing choking.

Drug interactions with body functions can cause difficulty in swallowing. Some neuroleptic drugs create sensory confusion on the tongue, which disrupts the voluntary

steps of the swallowing process. Other drugs containing dopamine can prevent proper bolus forming as well as bolus transport (Bakheit, 2001).

Viscosity and Standardization

Bakheit (2001) claims that while the ideal viscosity for foods and liquids for neurogenic dysphagics has not been determined, his own work suggests that subjective measurements can be used, and are described as syrup-like, or yogurt-like. Such low viscosity liquids present little opportunity for patients to aspirate them. However, liquids thickened too much are frequently refused by the patients. To set an objective standard for viscosity, Bakhiet has implemented a viscometer to some success.

An early attempt at setting objective viscosity standardization took place at at a rehabilitation center in Baltimore. The case study involves a care facility that adopted a standardized diet to reduce the risk of aspiration, and to improve the lives of its patients. The protocol was designed by a dietician and two speech-language pathologists, who became their own trained sensory panel. The SLPs studied the food choices for swallowability, ease of bolus formation, and ease of bolus transport. The dietitian participated in the same measurements, but also made certain of the food choices would convey the proper nutritional values. After the food choices were made, and consistencies standardized, the patients were examined with videofluoroscopic imaging, as well as bedside evaluations, to determine the viability of the various products. Finally, the entire facility's staff was educated as to proper food viscosity, proper liquid thickness, and the most obvious signs of a silently aspirating patient. After four weeks of observation, patients showed high tolerances for the menu items, low incidence of aspiration, and decreased reliance on tube feeding (Pardoe,1993).

Another attempt at standardization was described by the National Dysphagia Diet Task Force in 2002. This is considered one of the first major attempt to standardize food and liquid viscosities, and to create a working lexicon of attribute diagnostics. These lists include subjective terminology as defined by a sensory panel, as well as objective terms as determined by food and liquid measurement devices. The primary list of descriptors was consolidated into eight major criteria: Adhesiveness, cohesiveness, firmness, fracturability, hardness, springiness, viscosity, and yield stress. Once defined, these terms were correlated with various food products using the TA.XT2 Texture Analyzer, which is an industry standard device with easy to use software. The machine tested various attributes including tensile strength, compression, adhesiveness, fracture, and shear. This information was then used to design a food texture measurement scale, which allowed researchers to benchmark food textures on a scale of 0 to 100.

The task force's next project was to devise a measurement of severities of dysphagia, and to determine which viscosities of foods and liquids would be appropriate for each. The outcome was a scale of seven levels of severity, and four texture attributes: thin, nectar-like, honey-like, and spoon-thick. This information was worked into a chart for each level, whereby various food groups are listed (soups, meats, desserts, etc.), and a list of recommended food items follow, along with a list of food choices to avoid.

Finally, the task force turned to VFSS barium swallow testing to mimic the viscosities of common food and liquid choices, and to track these viscosities throughout the swallowing process. This information was used to standardize viscosity attributes in a table measured in centipose (cP), at 25 degrees Centigrade (National Dysphagia Diet Task Force, 2002).

One scenario concerning the dangers of poorly trained foodservice workers was also brought to light by the ADA in 2002. The event took place in a Veterans' hospital whose policies allowed for nursing assistants to thicken the dietary supplements served to dysphagia sufferers at bedside. Apparently, due to being short staffed, less than fifty percent of the served liquids were at proper viscosity levels for such patients. The ramifications here are the dangers of silent aspiration among dysphagics, or inability of less lucid patients to report esophageal pooling. These oversights can leave the patients vulnerable to pneumonia, a common cause of death among patients with dysphagia (National Dysphagia Diet Task Force, 2002).

One year later, McCallum (2003) described the ADA plan as less than useful in real world application. This article deals with the standardizations of liquid viscosities in a care facility which was implementing a change in protocol. In this case, the National Dysphagia Diet's "levels" of liquid viscosity was called into question due to some ambiguity on terminology. The original levels were designed by a group of dietitians, objectively measured, and broken down into 40 food textures and 18 liquid textures. However, the staff in charge of the focus hospital was worried that the term "level" would cause confusion with the food preparers and nursing staff. Also, they found the need for two extra levels which were defined as Dysphagia Pureed, and Dysphagia Mechanically Altered. In addition, there were some concerns as to perceptions on the part of the food preparers.

To address these concerns, VFSS methods were used to diagnose a given patient's type and severity of dysphagia, to help with the standardization levels. The computer screens used by nurses and food preparers were also modified, with a pull-down option containing descriptions of the various viscosities appropriate for various patients. A Key Food Highlights feature was added to identify problems, and analyze the menus for necessary changes. Finally, an intensive education campaign was launched at all levels of employees, to get them familiar with viscosities appropriate to the different stages of dysphagia.

Objective Versus Subjective Testing

Viscosity is a controversial subject in the laboratory, and across the field of dietetics in general. Though many studies have been conducted to analyze the viscosity of dietary liquids, there has been little success at standardization. Devices that measure viscosity in cP are expensive, difficult to use, and impractical for use in institutional kitchens (Penton Media, 2005). Other, more practical devices developed to measure viscosity (line spread test, consistometer, etc.) make correlation of data between one device and another rather difficult. Meilgaard, Civille, & Carr, (1991) also describe sensory evaluation as very useful in product testing in the foodservice industry; however, they warn of inherent difficulties in this type of testing wherein the evaluation is not done under strict laboratory conditions. In these cases, various environmental factors can affect the sensory panelists' evaluations, and result in unwanted artifacts in the collected data.

In an effort to combine objective and subjective analysis, Mann and Wong (1996) describe a test they designed to compare the analysis of trained sensory panel members to the classic line-spread test. The function of this comparison was to develop an economical but reliable means by which hospital and long term care providers could utilize a simple objective measuring device to standardize foods and liquids for the dysphagia diet. The study was centered around some food preparation methods from a local hospital. The formulations all had been altered for viscosity levels, and were designed specifically for dysphagic patients. The sensory panel was highly trained and participated in sensory evaluations for a food research laboratory. Objective testing was done on a common line-spread instrument and timed. The results of the analysis proved a strong positive correlation between the two tests, giving the researchers the impression that even such a simple instrument can provide accurate and reliable standardization for food and beverages appropriate to the dysphagia diet.

Commercial Thickeners

A major study in the push to standardize food and liquid viscosity, Garcia, Chambers, & Molander (2005) have isolated liquid thickening as potentially the most important aspect in designing diets for dysphagic patients. Nearly 10% of residents in care facilities are prescribed thickened liquids. Of these, the viscosity levels are 60% nectar-like, 33% honey-like, and 6% spoon-thick. Speech-language pathologists (SLPs) were chosen as the focus of this study, and a survey was designed to determine which criteria they used to recommend the various viscosities, how the liquids were prepared, and how the patients seemed to accept the products. A sensory evaluation analysis expert was contacted to design the items and the instrument, which resulted in a 25-item survey to be reviewed by two 12-year veteran SLPs. The survey was hosted on a website, and was subsequently taken by 491 people.

The survey results indicated that almost 85% of respondents liked thickened liquid for dysphagic patients, and felt they were the most effective means by which to increase hydration, and decrease aspiration. The most common reasons for prescribing thickened liquids were delayed swallowing, and inability to control thin liquid (aspiration). The most common type of thickening agents used were “Thicken Up ®” and “Thick It ®.” The most common reasons for choosing these products were “Contract” and “I don’t know.” Perceptions as to patient acceptance of the products showed 48% of patients strongly disliked the products.

Another study by Matta, Chambers, Garcia, & Helverson, (2006) focused on these same commercially available thickening agents, and how well they altered the viscosity of six different beverages. The thickeners were “Thick & Easy ®,” “Thick & Clear ®,” “Thicken Up ®,” and “Simply Thick ®.” The first two agents are cornstarch based, with the second two based on natural gums. The six beverages to be modified were purified water, 2% milk, apple juice, orange juice, decaffeinated coffee, and Ensure Vanilla Plus.

The samples were prepared according to package instructions, and were stirred (or shaken) again just before service. A magnetic stirring device was used for consistency. Descriptors were decided upon in the panel, and eight terms were used: viscosity, graininess, slickness, starch, sour, bitter, metallic, and astringent. In addition, a base beverage was defined as a control.

The results of the test showed no appreciable performance of any single product. All products at honey-like and nectar-like consistencies tended to impart a flavor that overpowered the taste of the original beverage. Starch based thickeners created a high level of graininess, while gum based thickeners imparted a “slickness” on the palate. Gum based thickeners tended to be more consistent in viscosity levels than their cornstarch based counterparts. All thickeners at low viscosity imparted off-flavors such as metallic, sour, bitter and astringent.

A 2007 study looked at viscosity testing of commercially thickened liquids as compared with those thickened with "instant" thickening products. Three types of objective testing were utilized in the study, with the results indicating that commercially thickened liquids were more viscous than those thickened with the instant products, and were inappropriate for the dysphagia-friendly diet (Adeley & Rachal, 2007).

It is obvious that while the SLP and dietitians in hospitals and long term care facilities like the commercial thickeners for keeping patients nourished and hydrated; however, patients are less than appreciative of the fact that the flavor and consistency of thickened products can be very unappealing. One study attempted to try a different route in the pursuit of quality patient care. Nixon, (1999) describes a study whereby 40 subjects suffering from mild to moderate to severe oropharyngeal dysphagia are evaluated using a videofluoroscope and barium swallow. The subjects were given two separate barium swallows, one with the viscosity of a thin liquid, and one with the same viscosity that had been carbonated. The VFSS was used to carefully monitor the subjects' laryngeal elevations, oral transit times, pharyngeal transit times, esophageal pooling, penetration, and subsequent aspiration. This measurement found statistically significant decreased bolus formation, decreased pharyngeal transit time, and decreased incidents of aspiration. 73% of subjects who aspirated single thin liquid swallows did not aspirate single carbonated swallows. The results of the study indicate a potential trending away from the very popular commercial thickening agents toward the use of carbonated beverages. Some positive outcomes of this include ease of standardizing viscosity with carbonation, as opposed to the variability involved with commercial thickeners, the potential for improved hydration in otherwise frequently dehydrated patients, and happier patients, who in general dislike commercial thickening products.

It would appear that there are as many problems concerning standardization of viscosities as there are causes of dysphagia. In addition, the variance in methods from institution to institution confounds the issue, creating more confusion rather than less among workers in healthcare foodservice. To make matters worse, commercially available products such as the aforementioned thickeners are unappealing to patients who may refuse them; a vicious circle leading back to poor patient nutrition and hydration. This situation would suggest that further, similar investigations are indicated, in addition to research as to general knowledge levels among food preparers in healthcare facilities.

The Swallowing Process

The swallowing process takes place across five stages: anticipatory, preparatory, lingual, pharyngeal and esophageal. Observance of the anticipatory stage is important to isolate problematic behaviors such as aversive responses to visual or olfactory stimuli as provided by the foods. Also, at this stage an observer should note inappropriate food choices, and impulsive behavior which could lead to difficulties. The next stage, or preparatory stage, is the point when food is placed in the mouth, mastication takes place, and the bolus is collected on the tongue in preparation for transfer. The lingual stage occurs as the tongue contracts, squeezing the bolus centrally and posteriorly toward the oropharynx. The pharynx then elevates in anticipation of the bolus. The pharyngeal stage is accomplished as the larynx moves, permitting vocal cord closure, which terminates respiration, and lessens the chance of aspiration. Then, the pharyngeal muscles contract, and the bolus is transferred by peristalsis to the esophagus. Finally, during the esophageal stage, the larynx lowers to its resting position, and through peristalsis and gravity, the bolus is transported through the esophageal segments and into the stomach. Viscosities of foods and liquids can directly cause the breakdown of any one of these stages, or a combination of two or more stages (Leopold & Kagel, 1983). However, in addition to viscosity concerns, particle size and number of particles in food play a large part in bolus formation, and the swallowability of a food type. Swallowing depends upon the ability to sense when food particles are of an appropriate size and number to bind together in preparation for bolus formation and transport (Prinz & Lucas, 1997). Image analysis research indicates that granularity must be at a very specific level before a bolus is appropriately prepared for transport (Mishallany, Woda, Labas & Peyron, 2006). With dysphagic patients, these levels are even more crucial, and thus quality testing procedures must take all of these factors into consideration.

Sensory Evaluation of Textures

While objective testing can determine a product's viscosity better than can human subjects (Mann & Wong, 1996), determining particulate size and number nearly always requires sensory evaluation. Research published by the *Journal of Texture Studies* defines texture as a sensory quality, as well as a multiple parameter quality. This same research describes using multiple treatments and correlations of texture in an attempt to understand the human sensory evaluation of test foods (Szczesniak, 1986).

Food surface texture has been described as being a function of features that perceivable by visual and tactile senses (Chen, 2007). "By definition, texture is a sensory property" (Szczesniak, 1986), whose perception ranges across several parameters; thus sensory testing should be examined using multi-disciplinary approaches. While research is limited on using secondary tactile components with traditional sensory evaluation, there is work being done by which to study the tactile “hand-feel” of foods. Early studies involved evaluating liquid dairy products based on their hand-feel (Kapsalis & Moskowitz, 1978). Chen (2007), describes studies in which food products were analyzed by sensory panelists who not only masticated the food, but also manipulated it with their hands. This research stemmed from textile evaluation, but used similar descriptors in the food experiment, including force to compress, resilience, stiffness, geometrical properties, fuzziness, and grittiness. Chen goes on to explain how the human mouth and the human hand are able to distinguish particles of very small size. The human mouth is sensitive enough to discriminate particles as small as 5 to 25 micrometers (µm). A study by Hollins and Risner (2000) suggests that the skin of the finger, if moved across sandpaper, can sense particles as small as 9 µm.

Depending on particulate qualities of shape and hardness, sensory panelists can detect particles in foods at sizes less than 22 µm. Hard, irregular particles are easier to detect; whereas soft, round particles cannot be detected under the size of 80 µm. (Chen, 2007). Considering the similar sensitivity shared by the human palette and the human finger pad, as well as the apparent benefit of combining sensory analysis with a tactile component, it appears indicated to create sensory tests which contain a tactile benchmarking instrument to assist researchers with subjective standardization of viscosities, particulate count and size diagnosis, and overall acceptability. In turn, such an instrument could be useful in further development of a descriptor lexicon as created by the ADA. Many facets of the food and beverage industry employ standardized lexicons for such variables as mouth-feel, or other sensory descriptors (Meilgaard, M., Dalgliesh, C., & Clapperton, 1979). A texture benchmarking instrument can assist researchers in sensory evaluation by making tactile the descriptors required for target attribute diagnosis. The instrument can blend the sensory experiences of touch and mastication. Descriptors are thus more easily conveyed to the test panel, and a more accurate lexicon could be developed.

Given the previous work done with sandpaper by Hollins and Risner, as well as the positive experience with the pilot study included below, the benchmarking instrument was constructed of varying grades of this material. The logic here is that sandpaper is manufactured to very exact specifications, and is measured by the µm. The finest grit discernible by the human hand is Coated Abrasives Manufacturer's Institute (CAMI) grade 1200. This coated abrasive is composed of particles that are 6.5 µm in diameter (0.00026 inch) (Sizes Inc., 2000). Data was collected at the interval/ratio level with this instrument, as there was a "zero" component. An interval scale is defined as consisting of ordered categories with intervals of exactly the same size. A ratio scale is defined as an interval scale containing an absolute zero value (Gravetter & Wallnau, 2007). As sandpaper is manufactured to such rigorous specifications, interval sizes are conceivable, as grade P80 (200 µm) is exactly twice as large as is grade P150 (100 µm). To create the zero component of the instrument, a square of waxed paper was added, thus containing no grit.

Well-defined measurements of the sensory properties of foods will contribute to creation of good predictors of reaching target specification (Kapsalis & Moskowitz, 1978). Despite the convoluted history of designing the dysphagia diet, and the attempts at standardization involved, recent work combining multiple sensory techniques may pave the way for a solid standardization at hospitals and long term care facilities by which foodservice workers can be educated. Creation of a descriptor lexicon through the use of benchmarking sensory panelists is crucial to the healthcare foodservice industry. Well-defined attribute diagnosis is key to understanding how sensory panelists perceive and learn. Based on Gibson's research with haptic and bi-modal learning, it stands to reason that blending techniques during sensory testing could provide a richer experience for the panelists, as well as a higher degree of accuracy in determining viscosity, particle count and particle size. Such research could assist in industry-wide standardizations, as well as creating better quality products less likely to be rejected by the patients, thus affording a higher quality of life.

METHODOLOGY

As previously mentioned, a texture benchmarking instrument can assist researchers in sensory evaluation by making tactile the descriptors required for target attribute diagnosis. Such an instrument can blend the sensory experiences of touch and mastication. Descriptors are thus more easily conveyed to the test panel, and more accurate results are achieved.

Therefore this study sought to include creating a texture benchmarking instrument designed to compare tactile sensations from the participants' fingertips with the particulate content and particulate size of the sampled product on their palettes. The primary concept was to use this instrument to demonstrate attribute descriptors and thus elicit a more accurate attribute diagnosis by which to create the lexicon. The instrument consisted of two components: the tactile component and the scorecard. The tactile component consisted of seven grades of abrasive paper affixed to a card. The grades ranged from no grains (waxed paper) to fine, to course. The scorecard consisted of seven rankings to correspond to the tactile component. Rankings consisted of 0= no grains to 6= extremely rough.

Based on Gibson's theory of affordance-based learning, the sensory panelists were put through a multi-stage training process. Initial benchmarking with honey (at 80 degrees Fahrenheit) afforded panelists with information required to rate control samples of pudding and pureed omelet. Rating control samples using traditional sensory testing methods (mastication) as well as haptic exploration of tactile card afforded them the ability to rate the non-control products using the tactile card, and diagnosing target attributes. Finally, the affordance of gathering information and categorizing it in the diagnoses of target attributes will further afford panelists to diagnose non-target attributes, thus expanding the original descriptor content of the lexicon established by the ADA.

All panelists were nutrition or hospitality undergraduate students in a research-based food laboratory class with a sensory testing component as part of their final research project. The panelists were benchmarked and given the control samples on the first day of testing. Non-control samples were administered to the panel on the second day of testing. The testing period was divided into two separate days due to time constraints.

The panelists were afforded training to sit and prepare themselves to swallow as would a dysphagic patient. Sitting up straight allows ease of the swallowing process, and calming oneself before attempting to swallow is important for impaired swallowers. A one-ounce portion of honey was provided to each panelist. The panel was instructed to sip a small portion of the honey (1/2 to 1 teaspoon) then to compress the honey between the tongue and upper palette noting count and size of present particles. Panelists were then instructed to allow the honey to accumulate at the back of the tongue until both gravity and peristalsis required them to swallow the bolus. The second portion of testing began with panelists sampling a pudding formulation that was prepared to honey-like consistency (Brookfield viscometer range of 351 – 1,750 cP.). The panelists sat up straight in the appropriate posture, and consumed the pudding in the same fashion as they had the honey previously. Panelists then were instructed to rate the particulate count and size of the pudding by touching the abrasive paper, and associating one level of abrasiveness with the corresponding rank on the scorecard. Panelists were then asked to determine whether the pudding's viscosity was honey-like or not. After this affordance, panelists were given a sample of a pureed omelet product containing cheese and avocado. The formulation was designed to afford them the experience of tasting a product made out of ADA specifications for the dysphagia diet. The omelet product contained many particles, very large particles, and was much thicker than honey-like viscosity. The panelists were then asked to rate the omelet product in the same manner as they had the pudding.

After this education, panelists were given formulations consisting of a pureed vegetable soup, a mint-chocolate shake, cucumber-yogurt sauce, a pureed beet soup, a pureed ham and cheese soup, and a strawberry shake. All formulations were prepared as closely as possible to the published recipes. All formulations were prepared in a controlled laboratory environment by staff familiar with dysphagia-diet testing. After sampling each, panelists were asked to haptically explore the tactile card, and to fill in the appropriate spaces on the scorecard. Panelists used the scorecard to determine particle size, and particle number. Panelists were then asked to rate the formulations as honey-like or not honey-like.

In addition, the data collection instrument contained a space for descriptors other than "honey-like, low particulate count, and large or small particles." These descriptors were considered non-target attributes, and were analyzed by content analysis to determine frequently mentioned phrases, as well as unique but pertinent phrases or descriptors. In this manner, the experiment may contribute to the lexicon of attribute descriptors used to assist researchers in sensory testing of dysphagia-diet-friendly formulations. The content analysis was conducted separately by two individual researchers to ensure inter-rater reliability. Both researchers were experienced with conducting qualitative research. Inter-rater reliability was calculated through the Joint Probability of Agreement method.

A total of eight separate formulations were tested, including chocolate pudding, avocado omelet, vegetable soup, mint-chocolate shake, yogurt sauce, beet soup, ham and cheese soup, and a strawberry shake. All formulations were made to original recipe specification, and all were blended to smooth consistency. The chocolate pudding and avocado omelet served as control products. The pudding was blended to honey-like consistency, and contained very few particles and very small particles. Particulate size and count was controlled as this formulation uses chocolate melted smooth for flavoring, and cornstarch for thickening. A Brookfield viscometer was used to measure the pudding, and confirm that it fell within the appropriate parameters to satisfy ADA's requirements for "honey-like" viscosity (Brookfield viscometer range of 351 – 1,750 cP.). In addition, the omelet product was designed to be outside the parameters of "honey-like" viscosity, and in addition was blended to contain many large particles. With these controls in place, the researcher was able to compare sensory panelists' ratings of the other six formulations for appropriate attributes.

The process of bi-modal, haptic learning would easily lend itself to sensory testing with an added tactile component for training adults to swallow in the manner of dysphagia patients. In addition, the ability to categorize during affordance adaptation would assist panelists in determining appropriate attributes for dysphagia-diet-friendly formulations and developing a descriptor lexicon.

Once all data were collected, they were analyzed using SPSS statistical software. The first two dependent variables (honey-like and not honey-like) were tested at the categorical level. The independent variables (formulations) were also tested at the categorical level. Frequency statistics were utilized to measure these variables for each formulation. All control and non-control formulations were measured with a Brookfield viscometer.

The third and fourth dependent variables (particle size and particle count, respectively) were tested at the continuous level, based on the 0 through 6 scale associated with the benchmarking instrument and scorecard. The researcher utilized the Kolmogorov-Smirnov (K-S) Z test for normality. This test was appropriate for this study as it allowed panelists' ratings of the products to be compared within groups. The K-S Z test compares continuous data from a sample distribution to a normal distribution (Lilliefors, 1967). For smaller samples, this is a powerful test of goodness of fit of distributions (Kerlinger, 1964). The K-S Z test allows for measurement of distributions with clustering scores. For this particular study, this is a useful measurement, as it revealed when sensory panelists were rating similar (or identical) attributes to the various formulations. Statistical significance would suggest that the panelists were in agreement as to attribute diagnosis of a given food product. Lack of significance would suggest that instead of clustering, the panelists' scores were approaching a normal distribution with much wider variance between scores.

This study was developed around a previous pilot study. The pilot study was designed to train a panel of sensory subjects, and to test the method of using a tactile benchmarking instrument in conjunction with a more traditional sensory test using only mastication and swallow. The results of the pilot study indicated that tactile benchmarking instruments are valid research tools in the attribute diagnoses of dysphagia-diet-friendly formulations. The second study contains several improvements on the pilot, including the use of a Brookfield viscometer to determine viscosity as opposed to a consistometer, as the former is a far more sensitive device. Also, the sample size of the second study was n = 40, a much more appropriate size for this type of research. As a sample size reaches n = 20, the sample will begin to approach a normal distribution (Gravetter & Wallnau, 2007). Finally, the tactile instrument was given an additional texture. This consisted of a square of waxed paper, affording the sensory panelists a tactile experience of "zero grains." The introduction of a "zero" component on the tactile instrument allowed the researchers to collect data at a continuous level. The training and testing was conducted in a laboratory environment, thus allowing the researchers to control the experiment.

RESULTS AND FINDINGS

Frequencies and Kolmogorov-Smirnov Z Tests

All non-control formulations were measured with a Brookfield viscometer (spindle #64 at 1.5 RPM). Spindle size and speed are chosen based on trial and error, and depending on the rheological properties of the liquids being measured. Appropriate spindle size and speed will produce a torque reading on the viscometer's digital display between 10% and 100% (Brookfield Engineering, 2005). Results of non-control products can be found in Table 1.

Table 1. Viscometer Readings of Non-Control Formulations in Centipoise (cP)

Formulation	Viscosity in cP
Beet Soup	1400
Yogurt Sauce	1600
Ham Soup	2399
Vegetable Soup	5199
Strawberry Shake	5999
Chocolate Shake	8798

It should be restated that the ADA recommendation for level 1 dysphagic patients is food pureed to honey-like consistency (Brookfield viscometer range of 351 – 1,750 cP.). While level two or three patients could probably control most of these sample foods, level one patients would likely have difficulty swallowing all but the beet soup and the yogurt sauce.

Sensory panel responses to the control formulations (pudding and pureed omelet) were a conflicting indication of the usefulness of the tactile component of the data collection instrument. Rated for particle size, the pudding exhibited small particles (M = .24, SD = .49); rated for particle count, the pudding exhibited few particles (M = .25, SD = .50). The omelet product was rated for particle size, and exhibited large particles (M = 4.38, SD = 1.32); rated for particle count, the omelet exhibited many particles (M = 4.75, SD = 1.02). Finally, when rated as honey-like or not honey-like, the pudding was rated as honey-like by 59.5% of the panelists. The omelet was rated as not honey-like by 83% of the panelists. These results would indicate that the benchmarking afforded the panelists a good standard by which to categorize foods as honey-like or not honey-like. In addition, at first glance the data suggest that the tactile instrument was effective in affording students a focus for attribute diagnoses. The low particle size/count mean scores for the pudding, in contrast to the high size/count scores for the omelet, would indicate accurate diagnosis.

Despite promising mean scores for the control products, data analysis was not as conclusive. The Kolmogorov-Smirnov Z tests indicated that panelists' ratings of the pudding particle number and size were clustering (z = 2.81, $p < .05$; z = 2.87, $p < .05$, respectively). However, K-S Z tests indicated that panelists' ratings of the particle number and size of the omelet did not cluster, and the scores were not statistically significant (z = 1.27, p = .07; z = 1.04, p = .22, respectively).

Results from the second day of testing were ratings of the non-control samples. Rated for particle size, the beet soup exhibited large particles (M = 4.76, SD = 1.43), and did not indicate clustering of panelists' scores (z = 1.09, p = .183). Rated for particle count, the beet soup exhibited many particles (*M* = 4.38, *SD* = 1.27), and did not indicate clustering of panelists' scores ($z = 1.08$, $p = .19$).

Rated for particle size, the yogurt sauce exhibited medium sized particles (*M* = 3.55, *SD* = 1.63), and did not indicate clustering of panelists' scores ($z = 1.12$, $p = .16$). Rated for particle count, the yogurt sauce exhibited few particles (*M* = 2.35, *SD* = 1.15), and did indicate clustering of panelists' scores ($z = 1.55$, $p < .05$).

Rated for particle size, the ham soup exhibited small particles (*M* = 2.70, *SD* = 1.61), and did indicate clustering of panelists' scores ($z = 1.61$, $p < .05$). Rated for particle count, the yogurt sauce exhibited many particles (*M* = 4.35, *SD* = 1.76), and did not indicate clustering of panelists' scores ($z = 1.05$, $p = .21$).

Rated for particle size, the chocolate shake exhibited very small particles (*M* = 1.13, *SD* = 1.54), and did indicate clustering of panelists' scores ($z = 1.83$, $p < .05$). Rated for particle count, the chocolate shake exhibited very few particles (*M* = .84, *SD* = .75), and did indicate clustering of panelists' scores ($z = 1.92$, $p < .05$).

Rated for particle size, the vegetable soup exhibited very large particles (*M* = 5.78, *SD* = 1.38), and did indicate clustering of panelists' scores ($z = 1.38$, $p < .05$). Rated for particle count, the vegetable soup exhibited very many particles (*M* = 5.52, *SD* = 1.45), and did not indicate clustering of panelists' scores ($z = 1.29$, $p = .07$).

Rated for particle size, the strawberry shake exhibited small particles (*M* = 1.80, *SD* = 1.54), and did indicate clustering of panelists' scores ($z = 1.38$, $p < .05$). Rated for particle count, the yogurt sauce exhibited small particles (*M* = 1.38, *SD* = .88), and did indicate clustering of panelists' scores ($z = 1.54$, $p < .05$).

When rating formulations for honey-like or not honey-like consistency, panelists were not in agreement with the viscometer measurements. Seventy-six percent of panelists rated the beet soup as not honey-like, whereas the viscometer measured this formulation as well within the ADA's parameters for honey-like. Seventy-eight percent of panelists rated the yogurt sauce as not honey-like, whereas it also was measured by the viscometer as being blended to specifications.

Sixty-one percent of panelists rated the chocolate shake as honey-like, and 64% of panelists rated the strawberry shake as honey-like. Both of these formulations were measured as too thick by the viscometer. Finally, 92% of panelists rated the vegetable soup as not honey-like, and 59% of panelists rated the ham soup as not honey-like, both of which were in agreement with the viscometer's readings.

Content Analysis

During both days of testing over the course of this research, space was provided on the various scorecards to allow the panelists to write down any descriptive attributes they were experiencing while evaluating the products. This portion of the instrument was able to elicit a very broad range of descriptors. During the content analysis process, the researcher divided the descriptors into five categories. These categories were Texture, Particles, Viscosity, Flavor, and Comparison. Descriptors assigned to the Texture category were those describing mouthfeel components such as "smooth," "creamy," and "mushy." Descriptors assigned to the Particles category specifically contained the word "particle" or terms such as "grainy" or "gritty." Descriptors assigned to the Viscosity category contained terminology about ease or difficulty swallowing, or terms such as "thick" and "watery." Descriptors assigned to the Flavor category contained terminology referring to taste such as "bitter," "sweet," or "tangy." Finally, descriptors assigned to the Comparison category contained terminology whereby the formulation was compared to something else, such as "honey-like," or "sand-like." The Joint Probability of Agreement method was used to calculate inter-rater reliability at 89.7%.

Panelist response indicated that for the pudding formulation, in the Texture category, the majority of panelists felt the product was "smooth." A few panelists used the term "creamy." One panelist used the term "light," and another said the pudding was "easily separated." No descriptors were placed in the Particles category for this product.

In the Viscosity category, a majority of respondents felt the product was "runny," while a fair number used the terms "watery," and "thin." A few panelists used the terms "liquid" and "liquidy." Individual panelists used the terms "less viscous," "does not run down easily," "easy to swallow," "not viscous," "satisfactory viscosity," and "hard to keep in throat."

In the Flavor category, a few panelists used the terms "sweet," "salty," "chocolatey," and "rich." Individual panelists used the terms "bitter," "bittersweet," "flavorful," and "good flavor."

In the Comparison category, the majority of panelists used the term "thinner than honey." Individual panelists used the terms "goes down throat easier than honey," "syrup-like," "like brownie mix," and "like hot chocolate."

Panelist response indicated that for the omelet formulation, in the Texture category, a few panelists used the terms "bumpy" and "mushy." Individual panelists used the terms "firm," "dry," "breaks apart," "crunchy," "awful texture," "chunky," "not smooth texture," "different mouthfeel," "heavy," "creamy," "coarse," "not smooth," and "rough."

In the Particles category, a majority of respondents felt the product was "grainy," while a fair number used the term "gritty." Individual panelists used the terms "large and small particles," "big grains," and "lots of little particles."

In the Viscosity category, a majority of respondents felt the product was "thick." Individual panelists used the terms "viscous," "non-liquid," "not liquid," "didn't flow easily," and "somewhat runny."

In the Flavor category, individual panelists used the terms "sour," "savory," and "good flavor."

In the Comparison category, individual panelists used the terms "thicker than honey," "potato-like," "rice-like," "mustard taste," and "mushed cottage cheese."

Panelist response indicated that for the beet soup formulation, in the Texture category, the majority of panelists used the term "smooth." Individual panelists used the terms "good texture," and "creamy."

In the Particles category, a majority of respondents felt the product was "grainy," while a fair number used the term "gritty." Individual panelists used the terms "particles," "large particles," "small lumps," and "lumpy."

In the Viscosity category, a few respondents felt the product was "thick." Individual panelists used the terms "thin," "easy to control," and "very thin."

In the Flavor category, a few panelists used the term "strong." Individual panelists used the terms "sour," "sweet," "off-putting flavor," "good taste," "unappealing," and "bitter."

In the Comparison category, an individual panelist used the term "similar to honey."

Panelist response indicated that for the yogurt sauce formulation, in the Texture category, the majority of panelists used the terms "foamy" and "smooth." Individual panelists used the terms "frothy," "soft" and "creamy."

In the Particles category, a few respondents felt the product was "grainy," and "gritty." Individual panelists used the terms "small particles," "few particles," "different sized particles," "chunky," "large chunks" and "lumpy."

In the Viscosity category, a few respondents felt the product was "thin," and "runny." Individual panelists used the term "watery."

In the Flavor category, the majority of panelists used the term "sour." A few panelists felt the product was "bitter." Individual panelists used the terms "strong," and "tangy."

In the Comparison category, an individual panelist used the term "tastes like ranch dressing."

Panelist response indicated that for the ham soup formulation, in the Texture category, an individual panelist used the term "starchy."

In the Particles category, a few respondents felt the product was "grainy." Individual panelists used the terms "gritty," "many particles," and "lumpy."

In the Viscosity category, a few respondents felt the product was "thick," and "easy to swallow."

There were no descriptors for this product in the Flavor category.

In the Comparison category, individual panelists used the terms “potato-like,” “like honey,” “close to honey-like,” and “sand-like particles.”

Panelist response indicated that for the chocolate shake formulation, in the Texture category, the majority of panelists used the term “smooth.” An individual panelist used the term “creamy.”

In the Particles category, individual panelists used the terms “had particles,” and “lumpy.”

In the Viscosity category, individual panelists used the terms “sticks in throat,” and “very thick.”

In the Flavor category, individual panelists used the terms “rich,” and “minty.”

In the Comparison category, individual panelists used the terms “like honey,” “thicker than honey,” and “did not flow like honey.”

Panelist response indicated that for the vegetable soup formulation, in the Texture category an individual panelist used the term “good consistency.”

In the Particles category, the majority of respondents felt the product was “chunky.” A few panelists felt the product was “grainy,” and “gritty.” Individual panelists used the terms “medium chunks,” “coarse,” and “clumpy.”

In the Viscosity category, individual panelists used the terms “not easy to swallow,” and “good flow.”

In the Flavor category, a few panelists used the term “bitter.”

In the Comparison category, an individual panelist used the term “dirt.”

Panelist response indicated that for the strawberry shake formulation, in the Texture category, the majority of panelists used the terms “creamy” and “smooth.” A few panelists used the term “fluffy.” Individual panelists used the terms “frothy,” “soft,” “fatty,” and “sticky.”

In the Particles category, individual panelists used the terms “few particles,” “few particles,” “grainy,” “gritty” and “not lumpy.”

In the Viscosity category, the majority of panelists used the term “thick.” A few panelists used the term “easy to swallow.”

No panelists entered descriptors in the Flavor category.

In the Comparison category, a few panelists used the term “thicker than honey.” Individual panelists used the terms “like pudding,” “not as thick as honey,” “same consistency as honey,” and “does not flow like honey.”

DISCUSSION

As previously mentioned, the theoretical framework for this study was based on Eleanor and J.J. Gibson’s model of affordance-based training and evaluation. Given the results of the control products and panelist response after the benchmarking process, it was expected that similar results would be achieved with the six non-control products. In other words, it was expected that for the formulations with higher viscosities, such as the strawberry and chocolate shakes, there would be less agreement between panelists, and the ratings would be in more of a normal distribution. However, this was not the case. For the two formulations blended to honey-like consistency (beet soup and yogurt sauce), only one variable (yogurt particle number) showed evidence of clustering responses. However, the results showed a total significant clustering of panelist response 58.33% of the time. While this percentage is far from immense, it still shows significance greater than half the time, indicating that the panelists were agreeing with each other as to the particle size and number of the products more often than not.

Overall, this is potentially a very useful method for increasing the accuracy of traditional trained sensory panels. Results of the pilot study supported this perception as well. However, in practice, the study was inconclusive, and showed unusual, if somewhat significant, results.

Honey-Like Consistency

The results of this aspect of the experiment were quite conclusive, and in agreement with the literature. Mann & Wong, (1996), conducted research indicating that objective testing is far superior in determining a product's viscosity than are human subjects. Likewise, Kapsalis and Moskowitz (1978) suggested that due to phase transformation due to body temperature, agreements between mechanical measurement and human measurements may simply be coincidental.

In the testing of honey-like consistency in this study, panelists were correct only 33.33% of the time. In addition, the two variables that panelists rated correctly (vegetable soup and ham soup) were very high in particle count and size, which may have made them very resistant to flow. While the chocolate and strawberry shakes were rated at a higher viscosity than the soups (5999 cP, 8798 cP, respectively), due to factors such as the phase transformation mentioned above, the highly viscous shakes were melting rapidly on the panelists' tongues, giving the sensory appearance of being less viscous.

These results demonstrate how important it is for recipe testers to practice good quality control for any recipes designed for the dysphagia diet. The viscometer is an excellent tool for determining appropriate viscosities for dysphagia patients; however, it is a very sensitive piece of equipment with many small and delicate parts. Such a device has no place in the environment of a large industrial kitchen, such as is found in hospitals and long-term care facilities. It is crucial that research and development teams are standardizing the recipes for dysphagia patients at their own end, leaving food preparers to simply mix and blend the formulation to specification.

Content Analysis

Results of the content analysis are potentially very useful. The high degree of agreement suggests that this is a valuable tool in creating a more comprehensive lexicon of attribute descriptors. In addition, many of the terms used by a majority of panelists were those most alarming to developers of dysphagia-diet recipes. For example, nearly all formulations were described as either “gritty” or “grainy,” by many panelists. This indicates a large number of particles, and a potential for much patient difficulty in bolus formation. Likewise, many descriptors included terms such as “large particles,” “many particles,” or “sand-like particles,” also indicative of foods whose attributes prove difficult to the swallowing impaired.

Also useful were many of the descriptors of food viscosity, including “hard to swallow,” “runny,” “watery,” “liquid,” and “does not flow easily.” All of these descriptors could lead to problems should they be attributes of prepared foods that make it to the dysphagia patient. As mentioned above, runny, watery liquids are difficult for sufferers of level one dysphagia to control. Frequently these types of foods lead to aspiration into the patient’s lungs, which can subsequently lead to pneumonia and death.

Likewise, foods difficult for healthy people to swallow, will pose a potential for choking in a swallowing-impaired individual.

Several of the texture-related descriptors were particularly alarming, as they were very similar in wording to foods that ADA recommends dysphagia patients of any level of severity should avoid altogether. These terms included “sticky,” “dry,” “crunchy,” “starchy,” “coarse,” and “rough.”

Flavor components were included in the content analysis due to the fact that ADA has suggested that bitter or overly sour formulations may be rejected by many patients. This category was primarily concerned with patient quality of life, rather than actually dangerous food attributes. Thus, there is value in isolating foods associated with these attributes, as healthcare facilities’ goals are to nourish and hydrate dysphagic patients, not give them foods they would prefer to avoid.

Finally, the comparison category could be very useful in that it might assist both sensory panelists as well as researchers. Panelists can use comparisons to other products or substances to more comprehensively describe what they are experiencing. Likewise, researchers could use the responses to more accurately understand the panelists, and to create a lexicon for future use, whereby these comparisons are used in communicating with other panelists.

LIMITATIONS AND FUTURE RESEARCH

The primary limitation of this study was the short period of training involved with the sensory panel. Given the difficulties inherent in using a tactile component during a traditional sensory evaluation, more time for familiarity with the instrument could have made a difference in the quality of results. The fact that the panelists were frequently in agreement as to the size and count of particles in the food they were sampling when compared to the tactile instrument indicates potential validity of the method. While the panelists were all familiar with sensory evaluation, the tactile component may have added an unwieldy variable to what had been a routine activity. In future studies, much more time should be given to training the panel to use the tactile instrument along side the traditional evaluation. In addition, it would behoove researchers to conduct norming sessions among the panelists, to assist them in using the instrument in a consistent manner.

A limitation of the experiment comparing viscometer ratings of honey-like consistency, with those of human subjects, was the wide variety of textures composing the foods. Like the tactile experiment, panelists should be provided with several similar control samples instead of one prepared within specifications and one prepared out of specifications. As the panelists begin to assess the formulations with some success, only then would non-control samples be introduced. Then, should panelists' responses still differ significantly from the viscometer readings, researchers would be more apt to consider this a function of the human palette, and not an artifact of variance of the sample textures.

Limitations of the content analysis are primarily associated with training the panelists well, as well as impressing upon them how important the descriptor attributes were to this research. Several panelists left the section completely blank, which negated the ability to add potentially useful terminology to the lexicon. Likewise, though instructed to only contribute descriptors relating to texture, viscosity, flavor, etc., many attribute descriptors provided by the panelists dealt with appearance or aroma of the samples, and thus had to be thrown out as useless data.

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CHAPTER V

DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

DISCUSSION

The two studies composing this research sought to answer four research questions. Several methods were employed in this endeavor, including a traditional paper survey, quasi-experimental design, and a qualitative content analysis. The results of all four research questions suggest that while they are all potentially valuable tools for organizations studying the problem of dysphagia, they also beg for more research and refinement.

RQ1.: What are the perceptions and knowledge levels among foodservice workers in the healthcare industry as to the issue of dysphagia, the needs of dysphagia patients, and the dysphagia diet?

Respondents to this survey included current workers in the healthcare foodservice industry. While the workers in question did enjoy a certain level of knowledge as to pureed foods and inappropriate food choices, the majority of respondents were not aware of some of the more dangerous aspects of caring for dysphagic patients, as well as their dietary needs. Perhaps most alarming was the very low percentage of workers who associated pneumonia with the aspiration of thin liquids. This is a major cause of death among the swallowing impaired. Also a concern with the low levels of awareness associated with allowing patients to wash solid foods down with liquids, or to attempt to eat in a reclining position. Both of these practices are very dangerous for dysphagic patients, and contraindicated.

Overall, the survey identified a low level of knowledge and many misperceptions among current healthcare foodservice workers, over half of whom reported to work with patients aged sixty years or more. A large percentage of these patients will be coping with some level of dysphagia over the next five years.

RQ2.: Given appropriate training, can a sensory panel diagnose honey-like viscosity in pureed food as accurately as a viscometer?

As supported by much of the literature, the results of this research suggests that a viscometer is far superior than is the human palette at detecting honey-like viscosity in pureed food formulations. While there is research to support the idea that human subjects can be trained to approach objective-like testing, this requires much training and norming sessions. Though given benchmarking education in the form of samples of honey, only slightly over half of the panelists were able to detect honey-like viscosity in the control product blended to proper consistency and verified by a Brookfield viscometer. Part of the reason for the discrepancy between objective and subjective testing of this variable is the impact heat has on many food products when encountering the human tongue and upper palette. Viscometer samples are not at this disadvantage, and in addition, may be held in water baths during testing, keeping sample temperature at a constant.

RQ3.: When added to traditional sensory testing, is a texture benchmarking instrument effective in assisting panelists to diagnose appropriate particle size and particle number in pureed foods?

The answer to this research question is inconclusive. Given the research that has been done with similar topics in the past, there appears to be a great deal of potential for this concept. Adding tactile components to traditional sensory evaluations provides panelists with a bi-modal experience which should increase many aspects of the sensory experience and allow the panelists to offer more accurate attribute diagnosis. The study is grounded in the seminal psychological theories of Eleanor Gibson, and the texture research of Szczesniak, Mann and Wong. These are authors at the forefront of multi-sensory experiential studies, and tactile evaluation of dysphagia-friendly formulations, respectively. Considering the background research with similar experiments, such seemingly random results indicate more training will be necessary for the panelists to reach agreements in suitable numbers. With proper refinement, this method has great potential to assist research and development workers in dysphagia diet design and preparation, as well as to take much of the guesswork out of food preparations in hospitals and long term care facilities.

RQ4.: Given affordance-based education for attribute diagnosis, can a trained sensory panel provide useful contributions to a dysphagia-diet descriptor lexicon?

The results of this experiment would indicate that affordance-based education for attribute diagnosis can afford sensory panelists with the knowledge and information needed to add unique, non-target attribute descriptors to a lexicon for proper and improper attributes of pureed foods. Large majority agreements of various terms, as well as terms well-known by dysphagia researchers as potential concerns were elicited from the sensory panel. In addition, many panelists used the method of comparing the food sample with another type of food or substance, which created a more accurate rapport between panelists and researchers, and which could assist in communication channels in future studies.

IMPLICATIONS AND RECOMMENDATIONS

Results of the first study indicate that perceptions and knowledge levels as to dysphagia and the dysphagia diet are sub-standard in many areas. While perhaps lacking in some manners, this study can provide researchers with a baseline for designing future research. It certainly brings to light the fact that there are some misperceptions and a lack of specific knowledge about important aspects of treating and feeding this growing population. This study allows for a brief look into the knowledge levels and perceptions of those individuals currently employed in this field, many of whom interact with dysphagic patients on a daily basis. These results imply that these workers could only benefit by further education and training, especially considering the low levels of knowledge associated with some of the more potentially hazardous methods in treating the swallowing impaired.

This study would be greatly enhanced by contacting management at several large facilities representing the Northeast, Midwest, and east and west coasts of the United States. Also valuable would be measuring responses from large inner-city facilities in urban centers. In this manner, the researchers would be privy to a much broader range of data, and would be able to look at variances within and between groups. In addition, this method would increase the variability of the demographic groups being surveyed.

Results of the second study indicate that much more research needs to be conducted in order to refine the means by which sensory evaluations are utilized with bi-modal style learning, as well as with objective testing components. Discrepancies between objective and subjective analysis may prove valuable to future researchers in determining which aspects of dysphagia-diet friendly foods are analyzed by which method to the best accuracy.

While the addition of a tactile component to the traditional sensory evaluation has enormous potential in assisting dysphagia-diet researchers, much refinement is indicated to norm panelists and assist them in using the tactile instrument to its full capacity in organizing and diagnosing accurate target attributes.

Finally, the use of open-ended components to data collection instruments to elicit non-target attribute descriptors also seems potentially very valuable to an organization such as the American Dietetics Association. These organizations are at the forefront of dietary standardizations for the dysphagia diet, and could thus benefit from development of an attribute descriptor lexicon. Such a lexicon could prove invaluable in creating accurate and open discourse between researchers and sensory panelists, as well as between researchers and future panelists who will need to be trained. A broad range of accurate descriptive words that have been assembled through empirical testing can only help such organizations in increasing the quality of life of their patients.

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APPENDIX

The researchers involved in this study are attempting to determine knowledge and perception of nutrition/foodservice-related healthcare workers concerning the effects of dysphagia. While it is a condition that can affect people in any stage of the life cycle, we are interested in the Baby Boomer generation as dysphagia often occurs during the process of aging. The focus of this study is age 60 and over.

The following questionnaire will take approximately five to ten minutes to complete. Your participation in this survey is important and appreciated. This survey is entirely voluntary and all participants may cease to participate at any time. All participants will remain anonymous. Thank you for participating.

1. Do you work with patients aged sixty years or more?

Yes

No

2. Are you familiar with the term "dysphagia?"

Yes

No

3. Dysphagia means:

a. The inability to taste

b. The inability to smell

c. The inability to swallow

d. The inability to feel pain

4. Patients with severe dysphagia (Level 1) require liquids to be very thin, such as water or juice.

True

False

5. Patients with severe dysphagia require solid foods to be pureed.

True

False

6. It is recommended that foods prepared for the dysphagia diet be which consistency?

a. water-like

b. cream-like

c. paste-like

d. honey-like

7. Aspiration occurs when patients are unable to swallow liquids which then enter the lungs.

True

False

8. The primary concern about patients aspirating liquids is the potential for:

a. choking

b. malnourishment

c. pneumonia

d. dehydration

9. Common causes of dysphagia include:

a. Huntington's disease

b. Alzheimer's disease

c. Multiple sclerosis

d. All of the above

10. Swallowing can be greatly facilitated when patients are in a reclining position.

True

False

11. Dysphagic patients in long-term care facilities have a significantly shorter life expectancy than do non-dysphagic patients.

True

False

12. A good way to assist dysphagic patients in the swallowing process is to have them wash down solid foods with liquids.

True

False

13. Corn flakes are an example of a safe food for severe dysphagics.

True

False

14. Egg-salad is an example of a safe food for severe dysphagics.

True

False

15. Thickened diet-supplement beverages are ideal to serve dysphagic patients for all three meals.

True

False

16. When feeding a dysphagic patient, the ideal amount for a single bite is:

a. 1 - 2 tablespoons

b. ½ - 1 teaspoon

c. 1/8 cup

d. as much as the patient wants

17. The most important consideration when planning a dysphagic patient's diet is that the foods be:

a. lactose free

b. fat free

c. high in fiber

d. high in calories

18. In 2002, which group appointed a task force to compile a report on dysphagia?

a. The American Cancer Society

b. The Veteran's Association

c. The American Dietetics Association

d. The American Geriatrics Society

19. What is your current age?

a. 18 – 21 e. 36 – 40 i. 61 or over

b. 22 – 25 f. 41 - 45

c. 26 – 30 g. 46 - 50

d. 31 – 35 h. 51 - 60

20. With which ethnic group do you identify?

Asian

African-American

Hispanic

Native-American

Middle-Eastern

Caucasian

Other

21. What is the highest level of education you have completed?

High-school

Some college

Bachelor's degree

Master's degree

Doctoral degree

Thank you for taking the time to complete this questionnaire. The researchers based the items contained in this instrument on the National Dysphagia Diets Standardization for Optimal Care.

Should you wish to contact the researchers for any reason, please send electronic mail to: charles.broz@ttu.edu

Thank you again for your participation.

I.D. #________________ **Date________________**

INSTRUCTIONS:

Receive the sample tray, and note the sample code below according to its position on the tray.

Taste the samples from left to right while touching the tactile benchmarking instrument. Try to correlate the abrasive paper samples with what you are experiencing on your palette.

First, please evaluate the samples for PARTICLE SIZE.

1. HAM SOUP_______ **2. CH. SHAKE_______**

PARTICLE SIZE:

0 = NO PARTICLES

1 = VERY FINE PARTICLES

2 = FINE PARTICLES

3 = FINE TO MEDIUM SIZED PARTICLES

4 = MEDIUM SIZED PARTICLES

5 = LARGE SIZED PARTICLES

6 = VERY LARGE PARTICLES

This data collection instrument continues on the next page.

Now, please evaluate the samples for PARTICLE NUMBER.

1. HAM SOUP_______ **2. CH. SHAKE_______**

PARTICLE NUMBER:

0 = NO PARTICLES

1 = VERY FEW PARTICLES

2 = FEW PARTICLES

3 = FEW TO MEDIUM NUMBER OF PARTICLES

4 = MEDIUM NUMBER OF PARTICLES

5 = MANY PARTICLES

6 = VERY MANY PARTICLES

Please rate the sample as either HONEY-LIKE OR NOT HONEY-LIKE.

1. HAM SOUP_________________ 2. CH. SHAKE__________________

Please list any DESCRIPTIVE WORDS that occur to you as you taste and swallow the samples:

HAM SOUP	**CH. SHAKE**