CONSUMER BEHAVIOR IN 3-DIMENSIONAL VIRTUAL WINE STORES (REFEREED)

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Abstract

This paper introduces the theoretical and conceptual basis for an empirical study. It focuses on how virtual stores (accessible through the internet or CD) need to be designed for influencing wine buyer (purchase) behavior most favorably. The project includes the development and empirical evaluation of a model based on past research on consumer behavior and environmental psychology in real stores.

Introduction

Although the importance of the WWW as a marketing tool is growing rapidly, consumer needs and wants are still somewhat neglected. As a result, (not only) wineries report small percentages of sales online. Technical aspects dominate the conceptual development of internet shops and consumer behavioral and psychological aspects find little consideration. In particular, factors that make internet shopping a stimulating and fun experience remain largely unknown. While brick and mortar retailers have identified and make use of the large potential of hedonic shopping experiences, existing internet shops (such as winery sites or wine.com) completely disregard this perspective.

The research introduced here focuses on how to make visiting virtual wine stores a most stimulating and pleasing experience that actually generates sales. At present, very few three-dimensional stores exist online at all. Generating knowledge about this type of outlets will thus provide valuable insights for innovative wine marketers. The research specifically addresses the following objectives:

- To identify what and how store characteristics affect consumer cognition, affect, store and product evaluation, and finally purchase behavior.
- To determine the interaction effects between consumer characteristics and store

characteristics in the relations described above.

- To establish guidelines for developing efficient 3-D wine stores with desktop virtual reality.

LITERATURE REVIEW AND MODEL DEVELOPMENT

Terms and Definitions

Virtual Stores. Stores provide consumers with an opportunity to satisfy their needs, wishes and desires through shopping. “Virtual” describes objects such as stores, which – while not being physically present – perform similar or identical roles as “real” (brick and mortar) stores. They are also being referred to as “as-if” structures because virtual objects pretend to exist and deliver key services without being physically present from a space and time perspective. The fact that creation and access is based on electronic media distinguishes virtual stores from more traditional shopping opportunities where consumers place orders by telephone, fax or letter. Accordingly, this research is based on the following definition:

> *Virtual stores are rooted in electronic media and represent non-stationary shopping opportunities, which are not real in a space-time sense and where consumers cannot walk in.* (Diehl, 2002).

Classification of virtual stores. Despite an abundance of literature on electronic commerce, no generally accepted classification of virtual stores has emerged as yet. In the current consumer behavioral context a classification appears to be most appropriate that draws from two pertinent criteria: 1) the distinction whether or not the store is screen-based, and 2) the distinction between two- and three-dimensional stores (Table 1).

TABLE 1
CLASSIFICATION OF VIRTUAL STORES

	Virtual stores	
	Two-dimensional stores	Three-dimensional stores
Screen-based	- Catalogs	- Simulated 3D environments - Desktop virtual reality - Immersions by extended reality
Non-screen based	- 2D projections (e.g. through wide screen projectors, holographic images)	- Immersions through extended realities (e.g. multi-media projectors, wall systems) - Partial immersions (e.g. work bench) - Full immersions (e.g. Cave / VR projection space)

Almost all currently accessible Internet stores fall into the category of 2-dimensional virtual stores. For example, winery web sites imitate the structure of catalogs where consumers select the category (red, white, blush, sparkling wines), view the available assortment, and can retrieve more detailed product descriptions, images, and prices. Very few three-dimensional applications with 3D simulations or hints of desktop virtual reality exist at all. Prototypical applications can be found outside the realm of retailing, that is in real estate and computer gaming.

From a consumer behavioral perspective this is surprising, because three-dimensional stores offer more possibilities for providing powerful shopping experiences than two-dimensional counterparts. Within the 3D category, those stores provide the most intensive experience, which allow a high degree of immersion (i.e., caves). Corresponding 3D stores with a high degree of immersion allow for visitor movement

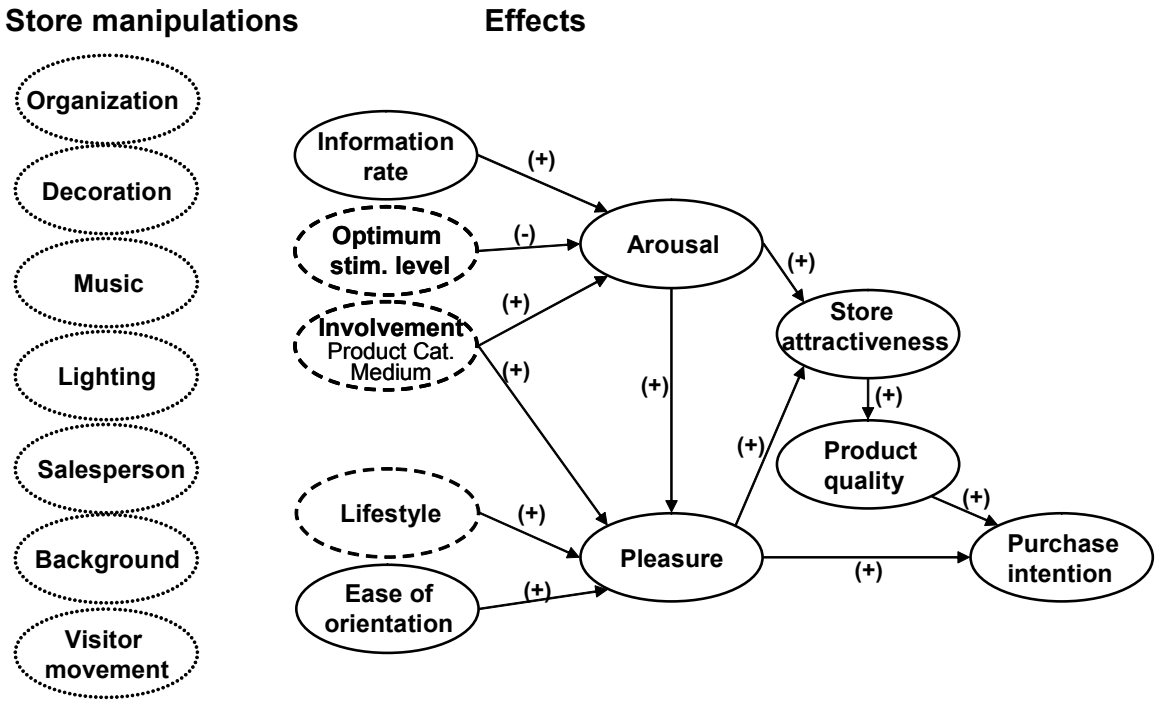
and interaction, offer multiple opportunities for user action, have a multi-sensory appeal, and provide more real product presentations and experiences.

Consumer behavioral model

Applicability of insights from brick and mortar environments. Model development starts with the question what if any consumer research findings can be transferred to virtual stores from studies that were conducted in "real", brick-and-mortar environments. There are several reasons to believe that store atmospherics and environmental psychology results may be generally applicable. First, there is evidence that consumers construe their reality based on real experiences as well as on media-based experiences, and that no distinction is being made between the two (Keen et al., 2004). Second, there is further evidence suggesting that the sources of individual experiences blur with the passage of time. This blurring originates in the fact that message content and source become disconnected over time, an effect also known as the "sleeper" phenomenon (McGuire 1985). In extreme cases, consumers no longer remember whether a specific experience was media-based or real. Third, three-dimensional virtual stores open a third dimension, allowing spatial visitor movement. With increasing possibilities to immerse and interact, getting absorbed in virtual worlds becomes progressively easier for visitors, leading to ever intensive and more real experiences of space and time. Finally, our language is saturated with terms such as cyber*space*, information *highway* or *surfing* the Internet, all indicating that people consider virtual worlds in terms of space. This additionally suggests that past findings in environmental psychology may be applicable to virtual worlds.

Conceptual model. The conceptual model draws from Mehrabian and Russell's (1974) approach to environmental psychology, which is substantially modified and extended. In its basic form, which has been found to be robust across cultures (Soriano, Foxall & Pearson, 2002), the model postulates that environmental stimuli trigger individual affective responses which in turn effect consumer behavior. Due to variation in personality, however, individuals respond differently to an environment. The following paragraphs detail the model shown in Figure 1 and integrate more recent research findings on consumer cognition, lifestyle, involvement, and affect.

FIGURE 1
MODEL FOR EVALUATION



According to Mehrabian (1978, p.16), the *information rate* is a measure for the sum of information that is available or perceived in an environment at a given time. A stimulus-rich environment hence is characterized by a high information rate which represents a combination of environmental complexity and newness. As long as an individual's optimum level of stimulation is not exceeded, such an environment offers multiple and different stimuli, and triggers psychological arousal and activation (Fiore & Kimle, 1997; Tai & Fung, 1997):

H1: A store's information rate is positively correlated with individual arousal.

Mehrabian and Russell (1974) did not report a relationship between *arousal* and *pleasure.* However, more recent empirical studies suggest that arousal is antecedent to pleasure (Diehl, 2002; Mattila & Wirtz, 2001; Sherman & Smity, 1997). This proposition finds additional support in optimum stimulation level research (Orth & Bourrain, 2004, Baumgartner & Steenkamp, 1996), where researchers demonstrated that consumers desire an individually optimum level of stimulation (arousal), which is closely related to

emotional response, and influences shopping responses (Eroglu, Machleit & Davis, 2003; Wakefield & Baker, 1998):

H2: Individual arousal positively effects pleasure.

Not included in Mehrabian and Russell's (1974) model are cognitive aspects which have attracted increasing attention in environmental psychology research over the past decade (Eroglu, Machleit & Davis, 2003). Particularly, the *ease of orientation* that characterizes a store environment has been found toa determine consumer response. Empirical studies showed that stores where consumers found it easy to orient themselves facilitated the development of mental maps and positively impacted the individually perceived shopping convenience, which in turn increased store attractiveness (Grossbart & Rammohan, 1981). Accordingly, the perceived ease of orientation within a store effects individual well-being and store perception, with individual pleasure increasing with ease of orientation:

H3: Ease of orientation positively effects pleasure.

A substantial body of research on environmental psychology examines effects of environmental stimuli on consumer approach/ avoidance behavior (see for a review). More recently, however, the recognition has gained acceptance that effects also exist on perceived *store attractiveness*, *product quality*, and finally *purchase intention* or choice (Baker, Grewal & Parasuraman, 1994; Chebat & Michon, 2003). In addition, examining these constructs will generate more managerial relevance and will provide more actionable results in the current context of e-tailing. For example, past research in environmental atmospherics showed that store environmental cues generate consumer affective responses which in turn effect the perceived attractiveness of the store (Donovan et al., 1994), particularly perceived pleasure exerts the strongest influence on consumer behavior in a store (Donovan & Rossiter, 1982). In addition, research on antecedents of store attractiveness suggests that the emotions and feelings consumers experience while shopping effect the image of an outlet (Chowdhury, Reardon & Srivastava, 1998; Lockshin & Kahrimanis, 1998). This image consists of several dimensions including store attractiveness and perceived product quality (Baker, Grewal & Parasuraman, 1994). Accordingly:

H4: Individual arousal will positively effect perceived store attractiveness.

H5: Individual pleasure will positively effect perceived store attractiveness.

H6: Perceived store attractiveness will positively effect perceived product quality.

H7: Individually perceived product quality will positively effect purchase intention.

Past consumer research has emphasized the importance of consumer *lifestyle* as a market segmentation variable (Wedel & Kamakura, 2002). Beyond the relevance for segmentation and target marketing activities, however, consumer lifestyle may have important implications for developing efficient virtual stores. In particular, the consumer perceived congruence between their lifestyle and store characteristics will likely effect preferences. In line with past research, a close fit between consumer self-concept and store image increases preferences, a findings that is also known as “match-up” hypothesis (Baker & Churchill, 1977). The closer the perceived match between consumer lifestyle and store image, the more favorable the store perception will be (Stern, Bush & Hair 1977) through pleasure as antecedent (Sirgy, Grewal & Mangleburg, 2000). Therefore:

H8: The individually perceived match-up between lifestyle and store image is positively related to pleasure.

Involvement describes the mental resources an individual is willing to commit to a decision problem (Mitchell, 1979; Celsi & Olson, 1988). While researchers frequently distinguish between high and low-involvement consumers, common involvement measures are based on a continuum (Zaichkowski, 1985; McQuarrie & Munson, 1992). Researchers have shown that consumer product category involvement significantly affects consumer processing of environmental cues (Eroglu, Machleit & Davis, 2003; MacInnis & Park, 1991). Accordingly, individuals who are predisposed to dedicate more attention and effort to a specific decision problem, i.e. shopping for wine, are more likely to respond with increased arousal. For example, if a person is very much involved with wine, then this person is likely to exhibit higher arousal when exposed to a store that offers wine than a person who is less involved with it. In the current context, this means that consumers who are highly involved with wine are likely to respond with higher arousal and pleasure when given an opportunity to visit a virtual wine store.

H9a: Individual involvement with the product category will positively effect arousal.

H9b: Individual involvement with the product category will positively effect pleasure.

On the other hand, higher involvement with the product category does not necessarily lead to more positive store perception since more involved consumers may be more critical. Involvement with the Internet – as contrasted against product category involvement - has been found to positively affect consumer behavior in terms of a predisposition (McKinney, 2004; Salam Rao & Pegels, 2000). Higher involvement with the medium therefore will likely result in a more favorable perception of the virtual store:

H10: Individual involvement with the medium will positively effect store attractiveness.

As mentioned before, Optimum Stimulation Level (OSL) theory postulates that individual behavior is influenced by the intrinsically motivate desire to accomplish a specific level of stimulation, termed "optimum stimulation level" (Berlyne, 1960). Consumer research established that this level varies between individuals (Raju, 1980). When the stimulation derived from the environment is too low, individuals will attempt to increase stimulation. When the stimulation is too high, individuals will attempt to decrease stimulation. Follow-up studies showed that consumer arousal or stimulation is related to OSL, and that both current and optimum stimulation effect behavior (Orth & Bourrain, 2004; Wahlers & Etzel, 1985). Therefore:

H11: An individual's optimum level of stimulation will positively influence arousal.

DEVELOPMENT OF A PROTOTYPICAL 3D STORE

Software

Video game sales reached $22 billion in 2003 and experts expect video game sales to outpace music sales by 2006 (PriceWaterhouseCoopers 2004). Such revenues have stimulated the development of highly sophisticated game engines. These game engines are currently being used for many purposes besides entertainment. To develop a flexible, 3D desktop virtual environment we will use Valve Software's Source engine (http://www.valvesoftware.com).

Modern game engines such as Valve's Source engine are capable of visual display and simulation that only a few years ago was unimaginable. An average consumer PC equipped with a reasonably capable video card can now produce visual simulation that as recently as five years ago would have required a prohibitively expensive high end workstation. Computer game technology represents the state of the art in interactive realistic environment generation. As such the game development environment is well suited to the creation of a desktop virtual environment. Furthermore, these engines generally allow game developers to customize the game by creating their own models, lighting, color, textures, audio, and animation.

Besides the standard modeling, animation, and rendering features, Valve's Source engine contains several other powerful features that make it useful for our project including a physics engine that allows the user to "pick up" and manipulate objects in the environment. It also provides some of the most compelling facial animation to date. Moreover, the source engine facilitates the creation of multiplayer games with communication via voice over IP and chat.

Valve's Source engine belongs to a family of "moddable" game engines developed over the last 10 years. Moddable game engines allow individual users to build their own interactive game, taking advantage of the rendering capabilities of the engine core. Developers can create new 3D environments or "levels", new characters or "entities", and completely new gameplay (story, character intelligence, etc.). While the actual rendering engine is not modifiable, the core can be extended, using the Software Development Kit (SDK) which provides handles into the rendering engine. The SDK for moddable game engines typically consists of source code for extending the capabilities of the game engine and a set of tools for creating levels, entities, and animations. These tools are optimized for creating 3D virtual environments and characters that run efficiently on the particular game engine.

Valve's SDK is comprised of several key components including the source code and the Hammer model editor. These components provide the bulk of what is needed to create a 3D virtual wine store prototype.

Store Characteristics

A prototypical store is being developed to facilitate the experimental manipulations required for evaluating the model. The basic store design will be obtained from an existing real wine store. Past environmental psychology research identified a number of variables influencing emotionally stimulating retail environments (Milliman, 1982; Turley & Milliman, 2000). Most prominent among those are lighting (brightness, highlights), color schemes (Stevenson, Bruner & Kumar, 2000), decoration (plants, curtains), and background music. Additional interactive features include organization of the assortment (Simonson, 1999), the possibility to move through the store, to select different perspectives, information retrieval (visual and acoustical), sales staff interaction, and participation in store design (Diehl, 2002).

Three major features characterize the innovative character of this prototype: 1) the store is three-dimensional, 2) allowing visitor real-time exploration. The latter means that visitor movement and interaction will be processed immediately resulting in continuously changing perspectives and environmental conditions very similar to computer games and professional training environments (airline pilots, NFL quarterbacks, law enforcement officers). 3) The store provides a multitude of user interaction features triggering real-time systems feedback. Among others, visitors may move through the virtual store, change perspectives, participate in store design, and request individual information. The specific options include features that allow to ...

- ... independently navigate through the store.
- ... switch perspectives (e.g. central, birds or frog perspective).
- ... move objects, grasp and examine products (wine bottles), open drawers, doors and cabinets.
- ... retrieve product information in writing or acoustically.
- ... download background music (classical, pop, rock).
- ... interact with sales staff (being greeted, exchange basic information).
- ... change colors and patterns (walls, floor, and ceiling).
- ... change decoration (e.g. wall pictures, wine barrels, rugs).
- ... change view through store windows (from default vineyard to mountains, beach or city).

- ... change lighting (dim or brighten, color schemes).
- ... change sales person (gender, age, dress style).

Prototype

The Room Model. The first phase of our development will involve the creation of the 3D models. This means that we create the 3D geometry that represents the actual world or store in which the visitors will be interacting. The primary components of the store are the room itself, the shelves, the wine bottles, furniture, and the room props. Props are secondary objects such as pictures on the wall, lamps, etc. that decorate and populate the store. The models will be built using the Hammer editor that is provided as part of the SDK.

Of particular importance in our 3D models will be the wine bottles. First, we will model the geometry of each bottle shape in the winery. Next, we create wine labels using a digital camera to obtain high quality digital images of actual wine bottle labels. We will use standard texture mapping capabilities to map these images of actual wine labels directly to the wine bottle geometry. This will allow us to create virtual bottles that look very much like the real bottles in the store with text clear enough to read. Each bottle will be designated as an entity that can be picked up, manipulated (i.e., rotated to view the back label), and placed back on the shelves.

Navigation. Users will be given the ability to move throughout the virtual environment using the mouse and arrow keys. The mouse will be used to adjust the facing direction while the arrow keys will move the user forward and backward. To pick up an object, the user will simply position the object in the middle of the screen using the navigation tools and then hit the “p” key to pick up the object. We will then provide methods for manipulating the bottle, for example, to view it from different angles. To put the bottle back down the user will again position the shelf location in the center of the screen and hit the “shift – p” key to place the bottle at that location. We will also provide the option to switch between various viewing perspectives including first person, birds-eye, etc.)

Once the modeling and navigation are complete, we will have a simple environment that a visitor can explore. We will then focus on creating a pipeline for

easily modifying the characteristics of the environment such as color, audio, and texture. We will create a simple file format that allows the experimenter to specify the particular colors, textures, audio tracks and lighting levels that he/she would like to use for the current experiment.

Extensions. There are several extensions that can be made to produce more compelling and more useful environments for experimentation. In future stages, we will convert the file format specifications for lighting, color, etc. to user interface elements that can be modified directly through user interface interaction (i.e., menus, buttons, etc). This will allow visitors to the store to "personalize" the environment. To that, we will add an animated salesperson. This salesperson will serve to greet the visitors to the environment, provide information, and add general liveliness to the environment.

Finally, the last step involves creating a multi-user environment. This means that multiple "shoppers" will be able to enter the store and shop for wine. These users will "see" one another as each will be embodied with a virtual avatar[a] that walks about and interacts with the environment based on the actions of the user that they represent. For example, one user may observe another speaking to the sales person or may watch a user walk to the shelves, pick up and view bottles. We will use IRC chat capabilities of the game engine to allow users to directly communicate with one another by typing text into a chat window.

Other extensions involve a more detailed model of the winery. For example, one might model the vineyards themselves and allow the visitors to walk through the vineyards or visit the wine cellar.

Given the powerful capabilities of Valve's Source engine, the possibilities are nearly limitless. We hope to exploit the engine as much as possible to create compelling and customizable environments that truly reflect the wine shopping experience.

[a] An avatar is a digital representation of a user in a virtual environment.

EMPIRICAL STUDY

Methodology

Object of the study is a 3-D store with desktop virtual reality (i.e. a virtual wine store where wines are displayed on shelves and that is staffed with one salesperson). An experiment will be designed to study a consumer sample of approximately 300 respondents. The sample will be split into several cells, each cell corresponding to one type of store manipulation. Manipulation variables include organization (wines presented by varietals or regions), decoration, background music, lighting, salespeople, background color, and visitor movement. Incentives will be offered to consumers (50% male, 50% female) to visit one store manipulation and to complete a questionnaire on independent (optimum stimulation level, lifestyle, product category involvement) and dependent variables (information rate, ease of orientation, arousal, pleasure, perceived store attractiveness, perceived product quality, and purchase intention). Data will be analyzed using a structural equations modeling approach. Appropriate store characteristics manipulations will be determined in a series of pre-tests prior to data collection.

Procedure

Respondents will be recruited to meet the specifications of a sponsor, i.e. from a consumer panel, and will receive a gift certificate for their participation.

Measures

Information rate. To measure the information rate associated with the store, Mehrabian and Russells (1974) multi-item battery will be employed, measuring respondent perception of novelty, complexity, density and size. In line with past research (Tai & Fung, 1997), the adequacy of the four-factor measurement model will be established through confirmatory factor analysis (Hair, et al., 1998). Ratings on the items will be averaged to generate mean scores for the four dimensions.

Involvement. Two established item batteries will be employed. Respondent involvement with the product category (wine) will be assessed through the item battery adapted and refined by De Wulf, Odekerken-Schröder and Iacobucci (2001). Individual involvement with the medium (Internet) will be measured through the scale developed

and validated by Salam, Rao and Pegels (2000).

Steenkamp and Baumgartner's (1995) Change Seeker Index (CSI) will be used for measuring *Optimum Levels of Stimulation*. This seven-item battery has been validated across cultures and has been shown to be superior to other scales in terms of nomological validity (Steenkamp & Baumgartner, 1995).

Lifestyle. The perceived match between individual lifestyle and store image will be measured using the scale detailed by Stern, Bush and Hair (1977).

Ease of orientation. Several measures have been employed in the past to assess how easy (or difficult) consumers find it to orient themselves in a retail environment. This study uses a single-item scale measured on a 7-point Likert scale: "I find it very easy to orient myself in this store".

Affect. Individual arousal and pleasure evoked by the store manipulation will be measured through Mehrabian and Russell's (1974) pleasure – arousal –dominance (PAD) scale. Although the third dimension, dominance, will not be included in the study, the adequacy of the original scale will be assessed through confirmatory factor analysis.

Perceived store attractiveness and *product quality* will be assessed through the multi-item battery introduced by Chowdhury, Reardon and Srivastava (1998). This scale includes several dimensions such as product quality, product selection, store atmosphere, store convenience, and prices and value, each measured through five to eleven items on a 7-point Likert type scale. The adequacy of the factor model will be determined through confirmatory factor analysis.

Purchase intention. Purchase intent will be measured through a three-item battery (Jamieson and Bass 1989): 1) "I believe this product is definitely right for me," 2) "I will definitely choose this product," 3) "I will definitely buy another product."

After the adequacy of the multi-item scales described above has been confirmed and the scales have been accepted, mean values will be computed for each construct based on the underlying item ratings. Consistent with past research, the aggregated measured will be used in further analyses to reduce model complexity.

EXPECTED RESULTS

Manipulation checks

To check the effectiveness of store manipulations, analysis of variance (ANOVA) will be performed to determine whether the treatments actually aroused varying levels of the constructs information rate and ease of orientation.

Comprehensive measurement model test

In keeping with the procedure recommended by Anderson and Gerbing (1988), a comprehensive measurement model will be estimated that included all constructs and measures subsequently used in the testing of structural relations. To evaluate the effects, a confirmatory factor analysis will be conducted (Steenkamp & Baumgartner, 2000) using AMOS 4.0 (Arbuckle & Wothke, 1999). Following tradition, the scale of measurement for the constructs will be established by setting one of the factor loadings to a default value of 1.0. The overall goodness-of-fit statistics for this comprehensive measurement model will be evaluated assessing χ(d.f.), *p, GFI*, *AGFI*, and *RMSEA* scores.

DISCUSSION

Results from this project will lead to a greater understanding of how characteristics of a 3-dimensional wine store with desktop virtual reality effect consumer affect, cognition, and buying behavior. Specifically, this project will result in:

- A quantitative model linking virtual store characteristics to consumer behavior.
- An identification of efficient store characteristics.
- An identification of consumer differences in the relationships described above.
- An identification of store-consumer match-ups that sell.
- A fully functional 3D store with desktop virtual reality.

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