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The Effect of Music on Shoppers' Shopping Behaviour in Virtual Reality Retail Stores: Mediation Analysis

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Abstract—The aim of this study is to investigate the effect of music, as an atmospheric cue of 3D virtual reality retail (VRR) stores, on shoppers' emotions and behaviour. To complete this research, a major empirical study was conducted in Second Life (SL) which is one of the most mature virtual worlds (VWs). The effect of the music on shoppers' emotions was experimentally tested in computer labs. Pre-test and post-test were conducted to evaluate the emotion levels before and after experiencing 3D VRR stores. Detailed mediation analysis was done with the PROCESS tool at the later stage of the analysis. This research confirmed 'music' as an atmospheric cue of 3D Servicescape. Results of this research determined the effect of music on shoppers' arousal, pleasure and consequent shopping behaviour. Further, this research could not identify the direct effect of arousal on shoppers' behaviour, however, it was a major source of inducing pleasure and increasing shoppers' positive approach behaviour. This paper contribute to better understanding the 3D VRR store atmospheric, role of music in it, shoppers' emotions and behaviour.

Keywords—Music; retail atmospherics; 3D virtual reality retailing; second life (SL); mediation analysis

I. INTRODUCTION

As a result of the huge technological developments in information technology (IT), shoppers are now able to shop from their homes using the Internet. This provided shoppers with another retail channel known either as web retail stores, online retail stores or web 2.0 retail stores. In this research, such first-generation offerings are called 'traditional' online/web retail stores. Beyond studying the conventional retail environment, academics have also explored the online environment and its effect on online shoppers. The first research in this area started in 1999 and was published in 2001 by Eroglu, Machleit, and Davis [14]. In this research, they posited that the online retail store environment affects shoppers in the same way as the brick and mortar retail environment [14]. This notion was later supported by a large

number of researchers [6], [8], [15], [26], [30], [31], [45], [53]. Though it has been just one and half decade passed since researchers started exploring the online retail atmospherics and its effect on different number of behavioural variables, there are now a large number of researches available.

The online retail atmospheric is not same as the brick and mortar retail [8]. There are many environmental cues that are missing in an online retail environment (physical layouts, temperature, olfaction etc.) and there are also many that are offered in the online retail environment but are not present in the brick and mortar retail environment such as content and navigation, etc. [38]. Different environmental cues in the online retail environment have been explored such as music and colours [53], layout and design [38], [64], web stores' quality and brand [6], and web graphics, links, and colours [31].

Today's shoppers have the new retail channel of 3D VRR in which to shop. A plethora of research has been done in the setting of brick and mortar & online retail environments and their effect on shoppers' emotions and behaviour [6], [10], [28], [38], [40], [64]. However, there are only four known studies, to date, conducted in the setting of 3D virtual reality retail atmospherics and their effect on virtual shoppers' behaviour [8], [24], [32], [65].

Online and web retail stores do not provide the same environment as brick and mortar or physical retail stores. Various atmospheric cues are missing in online retail stores e.g. face-to-face interaction. This can cause a lack of trust between customers and retailers [1]. However, such discrepancies are, or can potentially be, overcome in 3D VRR stores where virtual shoppers can see other avatars (either customers or employees) around them. Moreover, VRR stores provide a sense of walking, crowding, flying etc. that are not present in traditional online retailing [8], [65].

Previous research [8], [21], [24], [32], [65] indicate that the presence of virtual shoppers and their spending in 3D virtual stores is increasing day-by-day; however, research in the context of 3D VRR atmospheric is quite limited.

Hence, this study provides research parallel to that already undertaken in brick and mortar and traditional web/online/2D retail environments, but in the context of 3D VRR environments. This study consider Dad's et al. *3D Servicescape model* and aims to investigate the effect of 3D VRR stores' *background music* on virtual shoppers' behaviour, through the mediating variables of emotions (arousal and behaviour).

II. LITERATURE REVIEW

A. Virtual Reality and Virtual Worlds

Virtual worlds (VWs) are gifted by the merger of two technology based concepts: virtual reality and gaming world [58]. Researcher further argued that if the father of the VW is virtual reality then the mother is the gaming world [58]. However, these worlds are not only based on these two concepts but also on economy, sociology, business, law, biology, computer science and mathematics [58]. Messinger et al. [44] agree with Sivan [58] and believe that online gaming and social networks led to today's VWs.

Virtual reality is computer based electronic environment that provides immersion, interaction and imagination simultaneously. Virtual world is not a new concept, and it has been used by armed forces since 1962 [58]. Messinger et al. [44] also posited that antecedents of VWs are gaming worlds. Gaming worlds have been known to the world since 1978, and the first multi user game was MUD (Multi User Dungeon). MUD is a well-known first multi-user game, but it had no graphics and was totally text based. Other well-known gaming worlds are Ultima Online, EverQuest, The Sims Online, World of Warcraft, There.com, and Second Life.

At the beginning there were few users of VWs; however, this number grew gradually along with the gradual development in technology and greater broadband access with higher speeds at lower prices [44]. Today, VWs have been matured comparatively and a long list of VWs exists. Real life businesses are also considering these virtual worlds for their commercial activities [52]. According to Kzero [33], the number of VW users had reached around 671 million around the globe and their disbursement were \$1.8 billion of virtual assets. Users (residents) of Second Life (one of the most mature virtual world) alone did trade of \$150 million, only in the third quarter of 2009 [36]. This number later hit 21.3 million users [41], [56].

According to Kzero more and more individuals and businesses are taking interest in VWs and by 2012 the number of VW users has increased up to 2.1 billion [34]. This increasing interest by individuals and businesses has prompted VWs themselves to consider various segments of everyday life such as education, entertainment, health, business and special interests of individuals. It is proposed that sooner or later VWs will one day become a necessity for individuals and organizations [9].

B. Virtual Reality Retailing (VRR)

Three dimensional (3D) retail stores, also called 3D virtual reality retail (VRR) stores, provide a new and innovative mediums of shopping; such stores are full of opportunities for both retailers and shoppers [65]. These 3D stores, or VRR stores, are available in above discussed 3D virtual worlds. Arrival of such new shopping mediums facilitate shoppers with an alternative, enhanced and amended shopping experience, where shoppers (Avatars) purchase items for their virtual and real lives as well [8]. Avatars spend virtual money within these 3D virtual reality retail stores i.e. Linden Dollars are spent in one of the virtual world called Second Life (SL).

These 3D VRR stores are at developmental stage yet still closely providing a real world (brick and mortar) simulated retail environment [35]. 3D VRR stores, with the support of computer graphics, are built with majority of the brick and mortar retail environmental cues such as walls, colours, lighting, floors, background music, ceiling, layout and design [8]. One of the key environmental cues (social cue) of the brick and mortar retail environment was missing in traditional web retail environment. However, this limitation was covered in 3D VRR stores where virtual shoppers can experience other shoppers' avatars shopping around them. Moreover, sales staff can also be experienced in many 3D VRR stores [8].

Traditional web or online stores were using web 2.0 technology and hence had many discrepancies [21]. Such as product image in web 2.0 technology base online retail stores was not a true picture of the product, and social cue was missing in them and customers were not fulfilling their hedonic needs of shopping [8], [65], [67]. However, 3D VRR stores are providing an enhanced experience to the shoppers where they can pick a 3D electronic object, in the hands of their avatars, which is a close resemblance of the real world product. Furthermore, avatars can be customised (depends on the user's expertise) up to the exact appearance of the users in their real lives (such as their height, body shape, facial appearance, etc.); and hence, shoppers can try any cloth on their avatar before making the actual purchase.

Researchers in this research claims that though there is a large number of research in brick and mortar and traditional web retail atmospherics [3], [7], [11], [14], [15], [27], [31], [37], [53], [54], [59], [61], [64], [66], [69], [71], [74]. However, virtual worlds and virtual reality retail stores have existed since 2003 but, research in the context of 3D VRR atmospherics is still at its initial stage [8], [24], [32], [65]. There are studies investigating other realms within the virtual worlds but research to assess 3D VRR store atmospherics and their effect on shoppers' behaviour have been ignored [8]. To date there are only four known studies discussing about the 3D VRR store atmospherics [8], [24], [32], [65]. However, among these studies only Vrechopoulos et al. [65] actually explored *layout* as a 3D VRR store atmospheric cue and its effect on shoppers' behaviour. Other three named studies in this realm focused only to define and explain the VRR environment. Dad et al. coined the term '3D Servicescape' where they defined the whole 3D virtual reality retail environment [8]. 3D Servicescape model consists of 21 environmental cues, from virtual air to compatibility [8]. Researchers further called for a future empirical research to investigate the effect of

atmospheric cues of 3D Servicescape on virtual shoppers' behaviour [8].

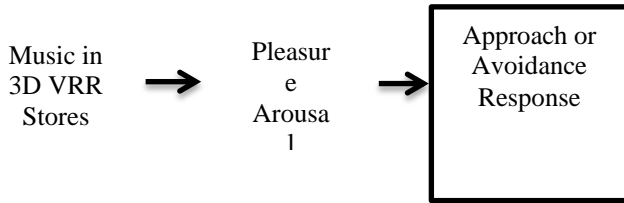


Fig. 1. Conceptual Model to Investigate the Effect of Music on Shoppers' behaviour in 3D VRR Stores.

This paper aims to investigate the effect of one of the environmental cue of 3D VRR store 'Music' on virtual shoppers' behaviour. Music has been focused a lot more than any other environmental cue, in physical [2], [16], [28], [29], [45], [46], [62], [72]-[75], and web retail atmospheric [47], [53] studies. Furthermore, in this research Mehrabian and Russell's affect model [42] will be adapted to investigate the effect of background music in 3D VRR stores' on shoppers' behaviour through the mediating variables of pleasure and arousal (see Fig. 1).

There are three principal rationales in adapting Mehrabian and Russell affect model: firstly, it provides a perfect theoretical framework to investigate the effect of any environment on human behaviour through the mediating variables of emotions; secondly, it benefits in measuring the possible emotional responses; and thirdly, this affect model empirically claims that it can measure the effect of any built environment on human behaviour [18], [42], [43], [55], [57]. On the bases of these three stated rationales it is believed that the Mehrabian and Russell's affect model would be appropriate to measure the effect of music, in 3D VRR stores, on shoppers' behaviour.

III. RESEARCH METHODOLOGY

The purpose of this research is to test the proposed conceptual model and the assumed relationships between variables. Researchers with theoretical interests (testing the conceptual model) should give their first priority to internal validity [5], but laboratory experiments are assumed to be appropriate for testing variable relationships, according to Wang [66]. However, the selected research design followed the 'natural field experiment' approach [22]. Experimental and natural conditions were utilized in computer labs; in this research, participants experienced 3D VRR stores through the electronic virtual world of Second Life, a 'natural setting', but under controlled conditions (an experimental setting). Controlled conditions were necessary as the responsiveness and robustness of Second Life depends on available Internet speed, the efficiency of the graphic cards and (generally) the age of the computer. The researcher needs control over extraneous variables and laboratory experiments were necessary to achieve the research objectives.

In this project, computer laboratories were used as a base for the research. This was because they allowed a highly controlled environment. Participants were controlled and guided through the research, but the 3D retail stores' environments were not manipulated at all. The studied real 3D

VRR stores were being visited repeatedly in a pattern, over a period of one and a half months.

A final questionnaire (being modified after taking experts' opinion and pilot study), used for the final study of this research, consisted of the five parts which contains items to measure arousal, pleasure, effect of 3D VRR background music and approach/ avoidance behaviour.

The first page of the questionnaire had a short description about the researcher, research purpose and how to fill the questionnaire. The first 12 items measured participants' emotions (pleasure and arousal). All 12 items were orthogonal (e.g. unhappy – happy), and participants had to rate their emotion on a six-point symmetric scale. These 12 items were adapted from Mehrabian and Russell [42], Donovan and Rossiter [11] and Newman [50]. Part 2 of the questionnaire repeated these two scales to measure pleasure and arousal (six items for each), to measure pre-test and post-test differences in the participants' emotions.

The third part of the questionnaire had items to investigate the effect of 3D VRR store environment cue (background music). These items to measure the effect of music on shoppers' behaviour were adapted from Vida [63]. The fourth part of the questionnaire had four items to measure participants' behaviour towards the 3D VRR store environment (either positive or negative). These four items were adapted from Newman [50]. A six-point symmetric scale (1 - 6: 1 for strongly disagree and 6 for strongly agree) was provided to answer the 3rd and 4th part of the questionnaire. The fifth and last part of the questionnaire had four demographic-related questions, such as age, gender, year of study and field of study.

In this research to examine 3D VRR stores, present in Second Life, the 'freebie'¹ stores in that VW were selected. None of the environmental cues would be manipulated and stores would be visited as they are, without any modifications, allowing all those environmental cues (stimuli) in each store could be explored.

A. Industry Selection

A convenience sample of university students would be used in the laboratory experiments. Most of the university students were between 17 and 34 years old. Apparel stores from the Fashion and Style category in Second Life were selected for this study, as such stores were thought likely to be of interest to the students (rather than, say, stores from the home and garden or land and estates categories). Prior visits yielded a number of locations in Second Life where students could find fashion apparel VRR stores. These selected stores are located in 'London Regent Soho Park', 'London City Shopping Centre', and the 'New York Shopping Mall' in Second Life.

B. Participants Selection

There were two significant groups in this study: respondents and retail environments. The determination of the

¹ Freebie stores, in Second Life, are offering (completely free) comprehensive essentials for avatars. Normally designers add new items in such stores on weekly basis.

sample size in classical inferential studies hinges on variability in the underlying characteristics of the population, and also on the desired degree of confidence in the outcome. There is therefore no available sample frame for the consumer population and a judgemental approach is necessary. Donovan and Rossiter [11] used a sample of 30 students in their study, but there is no standard sample size evident in retail environment studies. It varies from 30 [11] to 2098 [49]. Wakefield and Blodgett has 1836 participants [68]; Wang, Minor and Wei had 400 [70]; Noone and Mattila had 198 [51]; Ward et al. (2007) had 429 [71]; Nath had 2098 [49] and Krasonikolakis et al. had 104 [32], while exploring VRR atmospherics.

Convenience sampling is one of the simplest techniques for selecting accessible subjects (Marshall, 1996). Convenience sampling has been used in this research with 200 students from the five universities. The five Universities were: COMSATS, Institute of Information Technology, Wah Cantt campus; Riphah International University Islamabad, NUFAST, and Mirpur University of Science and Technology (MUST). These five institutes were chosen because of their IT reputation and because of their available infrastructure. The researcher also considered the feasibility of travelling between these five universities.

C. Data Collection in Computer Labs

In October 2014, the convenience sample members were invited to participate in the research, to begin in November 2014. The intention was to recruit 200 participants for the study. Participants were asked to register their accounts in Second Life and to familiarize themselves with the virtual world features, before actually taking part in the experiment. Laboratory visits were started at the beginning of November 2014 in a computer laboratory of the Computer System Engineering and Information Technology Department in Mirpur University of Science and Technology. The laboratory consisted of the latest computer systems and with 80 mbps Internet speed, sufficient enough to run Second Life. Students were invited in groups; each session consisted of 8 to 10 students. The researcher and one faculty member (Assistant Professor from the Power Engineering department, who had already been a user of Second Life for two years) acted as sales representative avatars, greeting and guiding students into the VRR stores. 63 students from MUST participated in total. 27 students from COMSATS Institute of Information Technology also participated. Even though the Internet speed in COMSATS was only 40 mbps, it did not make any difference in the running of Second Life.

In the cases of the 14 students from Riphah International University, Islamabad and 7 students from NUFAST, though these universities had the latest computer systems in their computer labs, the Internet speed was only 24 mbps. Therefore, the program could only run with a maximum of 4 students simultaneously in these locations.

A total of 118 students participated in this research. This was the number from the initial 200 participants who had been requested to open Second Life accounts and undertaken familiarization activities. However, 13 questionnaires had missing values on completion of the experiments, so a total of

105 questionnaires were considered and the 13 questionnaires with missing values were ignored.

IV. RESULTS AND ANALYSIS

A. Paired Sample T-Test

Measuring participants' emotions at two points: before experiencing the 3D VRR store *background music*, and after experiencing it should ensure that the particular environmental influences on the participants' emotions could be isolated. Otherwise, it was possible that participants' positive or negative emotions were not influenced by the 3D VRR store environment (*music*), but established before they came into this environment. The t-test is applied whenever comparing two means is required [17] and its requirements are met. There are two kinds of t-test; independent-samples t-test and paired-samples t-test. The paired-sample t-test pertains in a situation where there are two experimental conditions, and the same group of participants are assigned to those two experimental conditions [17]. The paired-sample t-test was applied here.

Researcher further argues that the difference in mean value of the two different situations should be different to zero, because it shows that there was a difference between the effects of two different situations [17]. If the mean value of the same participants' emotions at two levels (pre/post exposure) of this research were different, it meant that the 3D VRR store *background music* had a significant effect on participants.

Table I (see Appendix) shows that the mean value of pleasure levels of the participants' pre exposure was 4.6667 ('Pre-pleasure'). The mean value of pleasure levels of the same 105 participants after experiencing VRR store environment was 5.0635 ('Post pleasure'). Likewise, the mean value of the pre-arousal levels was 4.3643, whereas the mean value of the post-arousal levels was 4.7917.

Paired sample t-test correlation of Pair 1 (pre/post pleasure) is 0.539, which is highly significant at 0.000. For Pair 2 (arousal), the paired sample correlations value is 0.395, which is again significant at 0.000 (see Table II in Appendix).

The paired sample t-test (Table III in Appendix) shows mean difference between the pleasure levels pre and post at 0.39683 (standard deviation 0.80476), and 0.42738 (s.d. 0.91885) for arousal. The standard error mean for pleasure is 0.7854 and 0.8967 for arousal. As, by default, the confidence interval of SPSS is set at 95%, so the 95% confidence interval of the difference for pre and post pleasure is from 0.24108 to 0.55257. For pre and post arousal the confidence interval is from 0.24956 to 0.60520. It can be seen that the t-values of pleasure and arousal respectively are 5.053 and 4.766, with 104 degrees of freedom. The statistical significance (2-tailed p-value) of the paired t-tests for Pair 1 and Pair 2, (**Pr** ($|T| > |t|$) **under Ha: mean (diff) = 0**), which is 0.000. It can be seen clearly in Table III (see Appendix) that the p-value is 0.000, i.e., $p < 0.05$, for both pleasure and arousal (Pair 1 and Pair 2).

If the p-value is less than 0.05, there is a significant difference between two variable scores [17]. This paired sample t-test demonstrates that the effect of a VRR stores

background music on participants' emotion was highly significant.

B. Mediation Analysis

Mediation analysis is a contemporary approach to analyse the effect of independent variables on dependent variables, where there is a potential effect from intervening variables [20]. Hayes argued that any researcher who wants to investigate the effect of an X variable on a Y, may well postulate one or more intervening variables M between X and Y [23]. These intervening variables M are known as 'mediating variables'.

In this research, the *music*, as a cue of 3D VRR store environments, is independent variables, X, and the goal is an investigation into its effect on behaviour, which is the dependent variable Y. Here, the conceptualization is that 3D VRR store *music* (X) is affecting shoppers' behaviour (Y) through two mediating variables of emotions ($M_1 = \text{Pleasure}$, and $M_2 = \text{Arousal}$) (see Fig. 2 in Appendix).

Hence, instead of using Structural Equation Modelling (SEM), it was decided to run the PROCESS tool to check the relationships of independent, mediating and dependent variables, as it has advantages in this type of situation. The PROCESS tool is highly recommended by Field [17] for use when multiple regression analysis is required and the model also has mediating variables.

Mediation analysis shows researchers the direct effect of independent variables on dependent variables. Unlike AMOS (the SPSS SEM tool), it does not indicate the relationship between independent, mediating and dependent variables in 'one go', nor does it show if a conceptual model has more than one independent and dependent variable. Hayes suggested using PROCESS when accuracy is desired, even though more time will be taken on the experiment than by using SEM [23].

Mediation analysis is provided with a number of conceptual models, supported by appropriate statistical models in the software. There are two chief kinds of mediation analysis outlined by Hayes [23]. In simple mediation modelling, there is only one mediating variable between independent and dependent variables. However, in multiple mediation modelling there are two or more intervening variables.

Where there is more than one intervening variable, two forms of 'multiple mediation' are possible: parallel multiple mediation and serial multiple mediation. In parallel multiple mediation, the independent variable X affects dependent variable Y through two or more mediating variables. However, the model does not assume that the mediating variables affect each other. In serial multiple mediation, the model allows that one or more mediating variables are correlated with other mediating variables.

In this research, parallel multiple mediation was initially used. Here, the PROCESS tool was run, *music's* effect on the two mediating variables of pleasure and arousal, and the dependent variable of behaviour - approach or avoidance.

When PROCESS was run to find out the effect of *music* on behaviour, through the mediating variables of $M_1 = \text{pleasure}$ and $M_2 = \text{arousal}$, it was found that *Music* (X) affected pleasure and arousal at the same time, but arousal never affected behaviour.

As parallel mediation did not uncover the expected effects from arousal, serial multiple mediation modelling was then used. Serial modelling was found to give a better result, i.e. some of the expected effects were then discerned. It should be noted that the PROCESS command for parallel multiple mediating models and serial multiple mediating models looks the same. Hayes provides a series of model templates, conceptual and statistical, on which the mediation analysis may be based [23].

For serial multiple mediating, Hayes' Model 6 is used instead of Hayes' Model 4. Whilst using Hayes' Model 6 of the PROCESS command, the order of the mediating variables matters, but it does not whilst using his Model 4. Using Hayes' Model 6 of the PROCESS command, a sequential rationale is followed: arousal is taken as the primary mediating variable, and then pleasure levels are taken as the secondary mediating variable. Arousal is taken as the primary mediating variable, when the objective is to determine where (if anywhere) its effect is 'going', i.e. it is getting effect from the independent variable (*music*), but not affecting dependent variables behaviour.

The summary of the results is given below. The serial multiple mediator model consists of four indirect effects; whose values are the products of regression coefficients relating X to Y. The first indirect effect estimated is the specific effect of $X \rightarrow M_1 \rightarrow Y$ (*Music* \rightarrow *Arousal* \rightarrow *Shoppers' Behaviour*); the second indirect effect estimated is the effect of $X \rightarrow M_1 \rightarrow M_2 \rightarrow Y$ (*Music* \rightarrow *Arousal* \rightarrow *Pleasure* \rightarrow *Shoppers' Behaviour*); the third indirect effect estimated is the effect of $X \rightarrow M_2 \rightarrow Y$ (*Music* \rightarrow *Pleasure* \rightarrow *Shoppers' Behaviour*), and finally the fourth indirect effect estimated in the serial multiple mediator model is the total indirect effect that is estimated as the sum of all the specific indirect effects. These four indirect effects are output in the PROCESS results, alongside 95% bias-corrected bootstrap confidence intervals, based on 10,000 bootstrap samples [23]. If the bootstrap value does not include zero (between lower and upper limit confidence intervals – LLCI & ULCI) then the p-value is assumed to be less than or near to 0.05, which means an effect is significant.

C. Results of Mediation Analysis

Music significantly predicts arousal (M_1); as $b = 0.2743$, $p = 0.0006$ and t value = 3.5629 (see Outcome 1 in Appendix). *Music* does not affect pleasure (M_2) significantly, as $b = 0.0903$ with p value greater than 0.05 ($p = 0.1017$) and $t = 1.6514$ (see Outcome 2 in Appendix). Arousal, in Outcome 2, has a significant effect on pleasure with $b = 0.6450$, $p = .0000$ ($<.05$) and $t = 9.7640$ (see Outcome 3 in Appendix). In Outcome 3, arousal's effect on shoppers' behaviour is insignificant with the statistical values of $b = 0.0383$, $p = 0.7754$ and $t = 0.2861$. However, pleasure affected shoppers' behaviour significantly in PROCESS Outcome 3, with the statistical values of $b = 0.4484$, $p = 0.0024$ and $t = 3.1101$.

'Indirect effect path 1' (see Outcome 4 in Appendix), shows the indirect effect of music on arousal, then on shoppers' behaviour, which equates as music \rightarrow arousal \rightarrow behaviour. The first indirect effect is estimated as $0.2743(0.0383) = 0.0105$. This path of influence is not significant because the bootstrap confidence interval straddles zero (-0.0531 to 0.1119).

The second indirect effect is labelled as 'Indirect effect path 2', which shows the effect of music on behaviour in serial (music \rightarrow arousal \rightarrow pleasure \rightarrow shoppers' behaviour). The 2nd indirect effect is estimated as $0.2743(0.6450) 0.4484 = 0.0793$. This path of influence can be interpreted as significantly positive because the bootstrap confidence interval is above zero (0.0249 to 0.1826).

The third indirect effect, labelled as 'Indirect effect path 3', estimates the effect of music on pleasure, which in turn affects behaviour. The 3rd indirect effect is estimated as $0.0903(0.4484) = 0.0405$ (virtual air \rightarrow pleasure \rightarrow shoppers' behaviour). This path of relationships can also be interpreted as significant, because the bootstrap confidence interval does not straddle zero (0.0083 to 0.1089).

The serial multiple mediator model gives the sum of all specific indirect effects, which is known as 'total indirect effect'. The total indirect effect is 0.1304; this can be interpreted as significantly positive, because the bootstrap confidence interval is above zero (0.0402 to 0.3052).

Although the first indirect effect is not significant, the second, third, and total indirect effects are significant for music as an environmental cue of 3D VRR stores. Therefore, assuming total indirect value, which is significant, it is said that the total indirect effect is significant and even the p-value is deemed to be very close to 0.05. See Fig. 3 in Appendix for the effect of *music* on behaviour through the mediating variables of Arousal and Pleasure.

V. DISCUSSION OF THE RESULTS

Music is a cue that has been studied many times in previous research [4], [12], [13], [15], [19], [25], [28], [29], [39], [47], [53], [60], [62], [63], [66], [74], [75]. These researchers investigated different styles of music, different tempos, volume, whether to use the top 40 or classical music, and effect of music on shoppers' behaviour. However, all these studies were conducted either in brick and mortar retail environments or in traditional online retail environments. None of the research was conducted in an immersive 3D VRR store environment that explored the effect of music on virtual shoppers. However, Krasonikolakis et al. [32] suggested that music might have less or no effect on shoppers' behaviour in 3D VRR stores as shoppers can turn off the music while making their visit.

Despite their suggestion, this research found the comparable result that music has a significant effect on shopping behaviour, which is linked to shoppers' emotions. Among the three indirect effects of music on shoppers' shopping behaviour, two are found to be significant and positive. The sum of all indirect effects (total indirect effect) is also found to be positive and significant (see Outcome 4).

Previous research also found that different styles and tempos of music have an effect on shoppers' behaviour through shoppers' perceptions, attitudes, feelings and pleasure arousal levels. This research broadly confirms the previous studies and determines that, in 3D VRR stores, music is an important environmental cue that affects shoppers' emotions and behaviour in a positive way. It was found that the presence of music in 3D VRR stores affected shoppers' arousal and pleasure levels in a serial, and then affected approach behaviour. Music was found to significantly increase shoppers' arousal levels, which increases shoppers' pleasure levels, and then their approach behaviour. Pleasure also had a positive effect, separately, from music and then went on to increase shoppers' approach behaviour. However, arousal on its own was found not to affect shoppers' behaviour significantly in the presence of music in 3D VRR store environments.

Although most previous studies reported a significant and positive effect of music over shoppers' behaviour, Wang found that music was a source of irritation for shoppers if present in (traditional) web stores [66]. VRR stores are also a kind of online store, but they have features that make them different to traditional online stores. These 3D VRR stores are closer to the brick and mortar stores; shoppers' can experience a very similar electronic environment. That is why this study contradicts Wang [66], but confirms other studies [28], [62], [39]. Based on this study, music should be considered by all those retailers who wish to move towards 3D retailing, or for all those retailers who are already running their retail stores in these 3D VWs.

VI. CONCLUSION

This study is concluded as 3D VRR stores' background *music*, which significantly and positively affect shoppers' emotions, and subsequent behaviour. Though a previous study [65] did not find the effect of 3D VRR store environment (*layout*) on shoppers. This study also confirms Morrison, Gan, Dubelaar, & Oppewal [48] results in which it was found that the effect of environmental cues (music and aroma) on arousal, and high arousal levels themselves induced pleasure and behaviour positively. In this study, the results show that the second indirect effect path is significant which means that *music* induces shoppers' arousal, which subsequently increases shoppers' pleasure levels and positive behaviour.

Importantly, this research determines that in 3D VRR store environments, whilst adapting the M-R (1974) model, 'arousal' did not induce shoppers' behaviour directly.

a) Managerial Implications

The retail environment and its effect on shoppers' shopping behaviour is an important area of research among retail researchers. Brick and mortar and conventional high street retail environments have been investigated in a great deal since 1974. Moreover, online retail environments have also been explored thoroughly since their development. Newer VWs provide an innovative way of shopping (3D VRR stores), full of opportunities for both retailers and shoppers. One implication of this study is that retail management needs to maintain strategic perspective on the potential of 3D VRRs

to influence current business, both positively and negatively. 3D VRR should not be ignored.

By determining that 3D VRR stores' music have a great effect on shoppers' arousal and pleasure levels, it shows consequently the potential impact on their shopping behaviour. Therefore, 3D retailers are advised that they should be very careful when designing their retail stores in VWs and should follow the pattern of application that results here suggest. This study found that music, to be the environmental cues that induced the greatest approach behaviour. Although music here had a positive effect on shoppers' arousal and pleasure levels and subsequent shopping behaviour, this research also determined that it is possible that, if not manipulated properly, music could have a negative effect on shoppers' emotions and behaviour in 3D VRR stores. Therefore, future researchers and retailers should explore further why music has a positive effect on shoppers' emotions and behaviour.

b) Limitations and Future Studies

As with all research, this study is not free from limitations. The first limitation of this research is that only one type of speciality retail (apparel stores) was used to test the conceptual model. It is quite possible that other types of retail stores may have given different results. Therefore, in future studies other types of retail stores should be investigated.

Secondly, the sample used in this research was a convenience group of university students. Although they had good knowledge of VWs and most of them were technology-oriented, they were not actual users of the VW. Therefore, in future studies, actual users should be used in a sample to study their behaviour in 3D VRR store environments. Moreover, this small sample size (105 participants) does not allow the research to be generalized. Because of the time limitations and health and safety issues, the sample size and characteristics were acceptable, but future research should be done with actual visitors of 3D VRR stores, questionnaires should be filled in within 3D VRR environments, and a larger sample size should be used for generalization of the results. It would also be useful to pursue a different research approach, starting with the current population of web customers and studying their reactions to 3D VRRs. Thirdly, in this study, 3D VRR environments were investigated without any manipulation of the environment. Manipulation of the environment in an experimental approach could give better results for understanding and improving the 3D VRR store environments.

Another limitation of this research is the usage of limited dependent variables (arousal, pleasure and behaviour). Previous studies have explored satisfaction, feelings and other dependent variables induced in retail environments. In the future, researchers should employ other dependent variables other than arousal, pleasure and behaviour.

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APPENDIX

TABLE I. PAIRED SAMPLES T-TEST STATISTICS

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post Pleasure	5.0635	105	0.80840	0.07889
	Pre-Pleasure	4.6667	105	0.86510	0.08443
Pair 2	Post Arousal	4.7917	105	0.86839	0.08475
	Pre-Arousal	4.3643	105	0.79853	0.07793

TABLE II. PAIRED SAMPLES CORRELATIONS

		N	Correlation	Sig.
Pair 1	Post Pleasure & Pre Pleasure	105	0.539	0.000
Pair 2	Post Arousal & Pre Arousal	105	0.395	0.000

TABLE III. PAIRED SAMPLES TEST

		Paired Differences					T	df	Sig. (2-tailed p-value)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post Pleasure – Pre-Pleasure	0.39683	0.80476	0.07854	0.24108	0.55257	5.053	104	0.000
Pair 2	Post Arousal – Pre-Arousal	0.42738	0.91885	0.08967	0.24956	0.60520	4.766	104	0.000

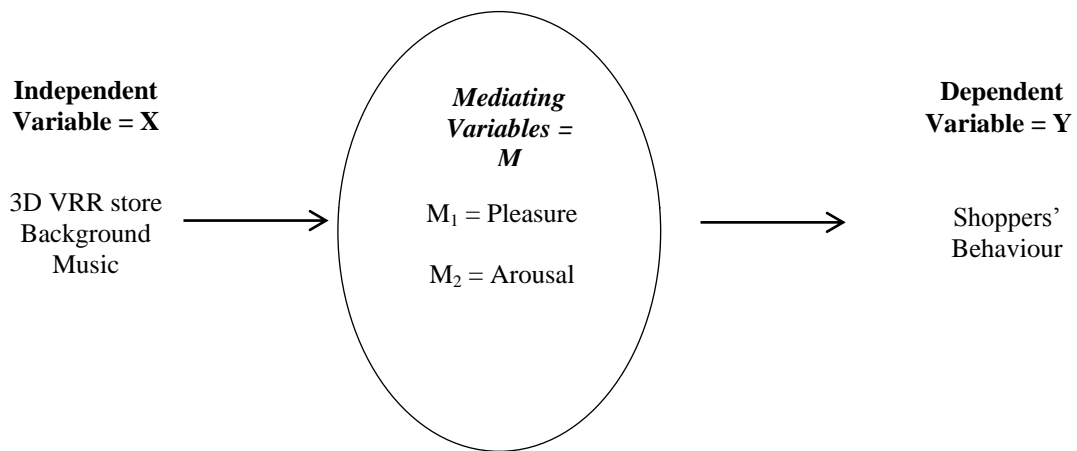


Fig. 2. Conceptualized 3D VRR store environment affecting shoppers' behaviour through mediating variables of Pleasure (M₁) and Arousal (M₂).

Outcome 1: Arousal						
Model Summary						
R	R-sq	MSE	F	df1	df2	p
0.3312	0.1097	0.6746	12.6942	1.0000	103.0000	0.0006
Model						
	Coeff	SE	T	P	LLCI	ULCI
Constant	3.4742	0.3706	9.3739	0.0000	2.7392	4.2093
Music	0.2743	0.0770	3.5629	0.0006	0.1216	0.4270

Outcome 2: Pleasure						
Model Summary						
R	R-sq	MSE	F	df1	df2	p
0.7382	0.5449	0.3032	61.0741	2.0000	102.0000	0.0000
Model						
	Coeff	SE	T	P	LLCI	ULCI
Constant	1.5663	0.3383	4.6305	0.0000	0.8954	2.2373
Arousal	0.6450	0.0661	9.7640	0.0000	0.5140	0.7761
Music	0.0903	0.0547	1.6514	0.1017	-0.0182	0.1989

Outcome 3: Behaviour						
Model Summary						
R	R-sq	MSE	F	df1	df2	p
0.5765	0.3324	0.6429	16.7606	3.0000	101.0000	0.0000
Model						
	Coeff	SE	T	P	LLCI	ULCI

Constant	1.1402	0.5418	2.1043	0.0378	0.0653	2.2151
Arousal	0.0383	0.1338	0.2861	0.7754	-0.2271	0.3037
Pleasure	0.4484	0.1442	3.1101	0.0024	0.1624	0.7344
Music	0.2745	0.0807	3.4011	0.0010	0.1144	0.4346

Outcome 4: Total, Direct and Indirect Effects						
Total Effect of X on Y						
Effect	SE	T	P	LLCI	ULCI	
0.4049	0.0819	4.9441	0.0000	0.2425	0.5673	
Direct Effect of X on Y						
Effect	SE	T	P	LLCI	ULCI	
0.2745	0.0807	3.4011	0.0010	0.1144	0.4346	
Indirect Effect(s) of X on Y						
	Effect	Boot SE	BootLLCI	BootULCI		
Total	0.1304	0.0649	0.0402	0.3052		
Indirect effect path 1	0.0105	0.0387	-0.0531	0.1119		
Indirect effect path 2	0.0793	0.0384	0.0249	0.1826		
Indirect effect path 3	0.0405	0.0243	0.0083	0.1089		

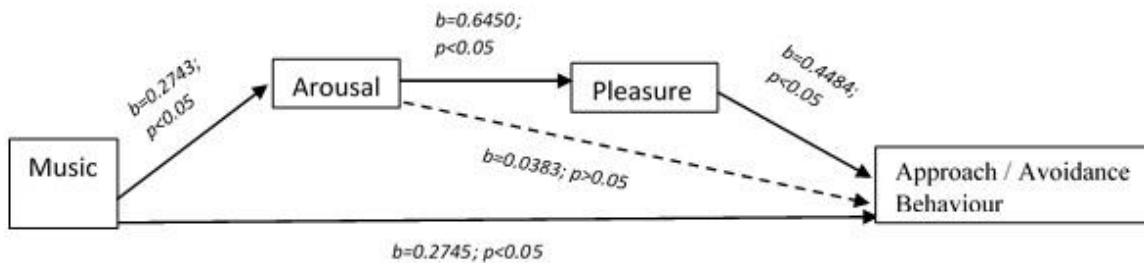


Fig. 3. Statistical outcome of 'music' affecting shoppers' behaviour through two mediating variables of arousal and pleasure.