The Influences of Virtual Reality Games on Media Identity: A Case Study of High-School students

SHIRABE Masashi* and BABA Yasunori†

* Department of Information and Culture,
Faculty of Art, Shinshu University
Asahi 3-1-1, Matsumoto, Nagano 390, Japan
Tel: +81-263-37-2279
Fax: +81-263-34-4171
E-mail: shirabe@gipac.shinshu-u.ac.jp

† Research into Artifacts Center for Engineering,
The University of Tokyo
Komaba 4-6-1, Meguro, Tokyo 153, Japan
Tel: +81-3-3467-0495
Fax: +81-3-3467-0648
E-mail: baba@race.u-tokyo.ac.jp

Abstract

This paper explores virtual reality game's influences on media identity. We first categorize the influences of virtual reality technology and discuss them. We study the category of influences caused by cognitive properties of virtual reality technology, which is important because developers of virtual reality technology have no control over these cognitive properties. We then examine data on high-school students who play video games. This data shows that there are some influences of virtual reality games on media identity, but these influences do not manifest themselves clearly.

1. Introduction

The practical use of virtual reality (VR) is still limited, although VR does have much potential. This is true not only because of technical limitations; there are limitations in non-technological aspects, e.g., artistic aspects and users' "literacy" (e.g., Goslin & For Morie, 1994; Sherman & Graig, 1995). The entertainment markets, especially the video game markets, have seen successful VR applications (e.g., Templeman, 1994). Entertainment applications have benefited from VR technology (Newby, 1994). We can learn something useful for VR technology from these entertainment applications. From this perspective, our study uses on the most popular fight-simulating games in Japan.

Although many studies have been made on VR technology, few attempts have been made on its social and personal impacts of VR technology; this is partly due to the fact that VR technology has not been in widespread, practical use. Presently, however, its applications are appearing in society, and the assessments of its technology on society become important and timely issues. This study, a preliminary one, is intended to assess VR technology, with a focus on video games.

To produce a sense of virtually "being there" is not a new phenomenon in the long history of media. Most preceding media have produced a sense of "being there" connecting with the audiences' imaginative powers. VR technology, however, can produce a reality-based sensation with little assistance from the audience. VR media stimulate a sense organ or organs by transmitting information that recreates a virtual 3-dimensional space. These stimuli then enable a recipient to visualize and

experience this space in his or her mental world. This is the definition of VR technology which we will use in this paper. Under this definition, the oldest VR technology is probably stereophonic sound technology, although it offers poor information on spatial relationships. Based on this definition of VR technology, we consider its influences on media identity.

2. Influences of VR Technology

In Table I we classify the influences of VR technology along two axes: the causes of the influences of VR technology and the levels at which such influenced are felt. Although there is room for debate on this classification, it provides a useful outline. A shaded section of this table will be explained later. Of course, the boundaries of this diagram are permeable.

Table I: Classification of Influences of VR Technology (1)

Causes \ Levels	Physical Level	Cognitive Level	Social Level
Formal Properties	•Nearsightedness •Video game	epilepsy	
Cognitive Properties	•"Simulator" sickness		•Appearances of new social
Social Properties	•Loss of strength	•Fabrication of "facts"*	relations •Military use

Note: Most of the above influences are not scientifically certified as correct.
*For example, Gulf War is taken to be fabricated (Baudrillard, 1991).

The vertical axis is related to the supply side of VR technology. We divided this axis into three categories.

First, formal properties include things like physical properties of stimuli (e.g., optical properties of a head-mounted display) and informational properties of stimuli (e.g., sampling rates of sounds). Second, cognitive properties mainly mean the contents, in a broader sense, of virtual experiences provided by VR applications. Cognitive properties also include organizations of stimuli; for example, a stereo phonic system provides only a sound stimulus, and the present VR technology provide no stimuli for the senses of smell or taste. The present VR technology focuses mainly on vision and hearing, and partly on touch and balance. Third, social properties mean situations and environments made possible by VR applications. For example, videoconference systems using VR technology enable people to work at home. This could dramatically change our lifestyles.

The horizontal axis is related to the receiving side of VR technology. We also divided this axis into three categories.

First, influences at a physical level include influences at the physical level include influences at

the chemical and biological levels. Thus, they are nearly equal to influences at a pathological level. Second, influences at a cognitive level include things like psychological influences (e.g., increase in aggressiveness) and changes in cognitive properties (e.g., changes in schema). Briefly put, the influences at the cognitive level are influences which generally do not at the physical levels within an individual. Third, influences at a social level are those that appear beyond the individual level.

This classification described here is for illustrative purposes only; thus, most of the examples in the diagram are not fixed in those positions. If a phenomenon was observed and understood as the result of VR technology, it could have various causes, and would have influences on various levels. If we also considered indirect causes and influences, many more would be shown.

The important point to note here is that we do not necessarily know how to avoid these influences (shown in Table I), nor do we understand the processes that produce these influences. To matter worse, we cannot yet conceive of the many future influences of VR technology. Nevertheless, VR applications have begun to proliferate in society. It is important to note that VR technology could have multiple positive aspects, particularly for disabled persons, for medical use, etc. Yet it cannot be denied that we know too little about the impacts to make an efficient cost-benefit analysis of VR technology diffusions.

Table II: Classification of Influences of VR Technology (2)

		Cognitive Level	
	Cause \ Continuance	Temporary influences	Continual influences
Cognitive Properties	Application-specific	•Increase in aggressiveness •Loss of keen senses	•Social maladjustment •Acquisition of <-> Loss of old ones
	VR-general	•Loss of a sense of existence •Confounding reality	a new literacy of media with virtual reality •Functional disorder in sensory integration

Note: Most of the above influences are not scientifically certified as correct.

Table II represents the shaded section of Table I in greater detail. VR technology differs much from many other technologies, including other information technologies, in the following way; VR technology depends heavily on and acts strongly on human cognitive processes. Thus, as there seem to be many influences in this category that we have not experienced or foreseen, this section is very important for technology assessments of VR. We therefore highlighted the section.

As this category of influences is closely connected with identity and media, we will use the term of "influences on media identity" to refer to the influences in the category.

3. Controllable or Uncontrollable

We would like to focus attention on the type of influences we must guard against as developers of VR technology. Naturally we should try to reduce the bad influences of VR technology and maximize the good influences. Most of the influences, however, have not been clear because VR technology applications are just beginning to appear in society. What we can do is to avoid pitfalls deleterious to VR technology and our societies.

Information technology is characterized by its acceleration of progress and its rapid diffusion (Shirabe, now printing). The use of VR technology is spreading, with its concomitant influences. Even if we could estimate the costs and benefits of VR technology, making such a cost-benefit analysis would be of little use. It is important that VR developers consider in advance the need to control VR's influences on society; once VR technology is socially distributed, it will be too late to deal with such influences. We should try to determine which influences of VR technology are controllable and which are not.

Logically speaking, most of the influences caused by the formal properties of VR applications are controllable. If the physical conditions of use are bad, the user's ears or eyes may be damaged. However, if developers caution users, such influences can be controlled. A person who always listens to sounds sampled at low rates may become unable to sense subtle differences in sounds. In that event developers should raise sampling rates, although this might be difficult for technological or economical reasons. Almost all of the components of the user's interface with VR are already existing. Thus, there are few problems peculiar to VR applications with respect to formal properties.

Influences caused by social properties of VR applications are hard to control, especially for developers. These influences are very important for technology assessments of VR. Although we do not know these influences well, problems caused by the social properties of VR must be solved through interaction between developers and society as a whole. Developers should not, of course, leave these problems alone. For example, developers can be against a military use of VR technology. It is beyond the scope of this brief paper to discuss such problems at a length. Instead, we will focus on influences of cognitive properties of VR applications.

VR applications make a person recognize stimuli in their mind so realistically that he or she may confuse VR with reality. Repeated cognition of realistic but virtual stimuli might reorganize cognitive processes. Unexpected cognitive processes may be stimulated as video game epilepsy. Many

influences of cognitive properties can and should be considered. There is space here only for discussing the influences classified in Table II.

It seems reasonable to suppose that the continual influences of VR applications are much more problematic than temporary influences, because we can reduce temporary influences simply by making users follow certain conditions of use or, in extreme cases, by isolating users temporarily. In other words, we can control temporary influences without discovering a remedy for them. On the contrary, with continual influences we need to determine actual remedies.

With respect to the other axis of Table II, influences caused by VR-general properties seem more important than those caused by application-specific properties. If VR applications cause the deterioration of children's personalities due to violent content, we could control such effect to some extent. For example, sales of sensational and/or violent video game software are regulated voluntarily and by laws in Japan, although such regulations are problematic from the viewpoint of the freedom of expression. In contrast, if VR applications in general have harmful effects, we can do nothing but abandon this technology, or at least find drastic means to control it.

With respect to whether the influences of VR applications are controllable or not, we should focus attention on the cognitive and social properties of VR applications when assessing the technology. Here we will focus on cognitive properties.

4. The Influences of Virtual Reality Video Games on Media Identity

4.1 Outline of a Survey and its Analysis

Assuming that cognitive properties of VR applications may create harmful effects, such influences are probably caused by repeated and deep immersions in virtual worlds. Video games offer these very experiences. This is why we focus on VR in video games here. Many studies have been made on the influences of video games, but the focus of this research is different from those prior studies. The purpose of such earlier studies was to examine the influences of video games as media. In contrast, the purpose of this study is to examine the influences of VR, although we deal with video games.

Last April, we distributed a questionnaire on media activities to 834 high school students. 743 answers were returned. Nearly half of the subjects were female.

In this analysis, we focus on the difference of Virtuafighter (VF) and Street-fighter (SF), whose main platforms are SEGA and NINTENDO machines respectively. These are the most popular fight-simulating games in Japan. Nascent VR technology such as texture mapping and 3-D modeling is

fully applied to VF. On the other hand, SF uses traditional animation technology. This difference between the two games allows us to isolate the influences of VR-general properties. Nearly 10% of the subjects in the above survey often play Virtuafighter and/or Streetfighter.

Recently, many VR games besides VF have entered the market. As VF is by far the most popular and most played VR game, it seems reasonable to use VF for this sturdy. Since SF is the only game that is as popular as (or more popular than) VF and is in the same category (fighting simulation) as VF, SF seems an appropriate counterpart.

It is well known that there are gender differences in personality, especially scaled by personality inventories. Thus, considering gender differences in the analysis of personalities, we will mainly use ANOVA.

4.2 VR Game's Influences on Personality and Attitudes to Media

Many studies have been made to show video games' influences on personalities. Judging from these psychological studies, one cannot conclude that video games have deleterious effects on personality, although this doctrine is subject to change (Sakamoto, 1993; Hashimoto, 1996). Several articles have been devoted to the study of video games' influences on attitudes to media. For example, video game players are likely to read fewer books (e.g., Yoshii, 1996). If subjects became immersed more in VR games' worlds than in other games' worlds, VR video games might have more influences on personality and attitudes to media.

In this section, subjects are divided into 5 groups as follows: Group I consists of subjects who rarely play video games. Group II consists of subjects who play video games but rarely play Virtuafighter (VF) or Street-fighter (SF). Group III consists of subjects who often play VF but rarely play SF. Group IV consists of subjects who often play SF but rarely play VF. Group V consists of subjects who often play VF and SF. The results are as follows.

Personality

5 scales of personality (aggressiveness, extroversion, inferiority, progressiveness, sympathy) are measured according to Yanai et al. (1987). On extroversion, inferiority and sympathy, only the main effects of gender are significant ($p<0.05$). The results are irrelevant to the purpose of this study. On aggressiveness and progressiveness, only the two-way interactions are significant ($p<0.05$). Then, Tukey HSD tests are executed for males and females. On aggressiveness and progressiveness, no two groups within males are significantly different at the 5% level. In contrast with the female groups, the average progressiveness scale of Group IV is significantly higher than those of Group I

and II ($p<0.05$), but no two groups are significantly different in aggressiveness at the 5% level.

Attitudes to media

Four scores on attitudes to media (the number of books read, the number of comic strips read, the number of magazines read, the number of hours watching TV programs) are measured. On books, neither main effects nor two-way interactions are significant. On comic strips, magazines and TV, only the main effects of the groups are significant. Tukey HSD tests without distinction of gender are then executed.

Subjects in Group II - IV read significantly more comic strips than subjects in Group I ($p<0.05$). The means of Group V are the same as Group II - IV, but the difference between Group I and V is insignificant. Subjects in Group V read many more magazines than those in Group I and II ($p<0.05$), and subjects in Group IV read more magazines than subjects in Group I ($p<0.05$). The means of Group III are the same as Group IV, but the difference between Group I and III is insignificant. As for watching TV, no two groups are significantly different at the 5% level.

Consequently, video games have little or no influence on personalities, and some influence on attitudes to media. There are a few differences between ordinary video games and VR video games with respect to the above issues.

4.3 Immersion and Involvement

Ford Morie (1994) believes that the virtual reality field is driven by the basic ideas of immersion and interactivity. Critical to further improvement in VR is yet another component, the component of involvement. It is possible to have involvement without interactivity and without full 3D immersion in a virtual space.

It is from this point of view that we shall consider the influences of VR video games. The relationship between immersion and involvement is the main focus, since immersion is the key to understanding the influences of VR applications at a cognitive level.

We set three following hypotheses to be tested. Judging from the recent developmental efforts of VR technology, these hypotheses seem reasonable.

Hypothesis 1: The more realistic a game is, the more the players are subjectively immersed into it.
Hypothesis 2: The more realistic the game, the more the players are involved in it.
Hypothesis 3: The more players are subjectively immersed in the game's VR environment, the more they become involved in the game.

The indicators, which related to immersion and involvements, were measured by certain questions. On immersion, a subjective range of vision in playing Virtuafighter and/or Streetfighter was measured. On involvement, sixteen questions related to the degrees of involvement were asked, and we measured the scale of involvement with principal components analysis (the first factor, which explains 48.5% of the variance).

Table III: Relation between Realism of Games and Players' Range of Vision

Number of Players	Range of vision including the background of fighters	Not
VF (more realistic game)	3	15
SF (less realistic game)	15	22

Note: $p = 0.076$ (x^2 test)

Hypothesis 1 is tested by the chi-square test for Table III. The columns are divided according to whether a subjective range of vision in playing games includes the background of fighters in a VR environment or not. Its rows are divided by playing Virtuafighter (more realistic game) or Streetfighter (less realistic game).

Hypothesis 2 and 3 are collectively tested by ANOVA. The dependent variable is the scale of involvement; the independent variables (factors) are the column and the row of the table in the test of Hypothesis 1. In these tests, subjects who often play both games are excluded, since it is difficult to distinguish games' effects from personal factors. The results are as follows.

Hypothesis 1 is uncertain. The ranges of vision of SF players tend to be slightly wider ($p<0.1$). Hypothesis 2 and 3 are refuted. The main effects are not significant (each $p>0.1$). The two-ways' interactions are, however, significant ($p<0.05$). According to the subordinate tests, subjects playing Virtuafighter with a wider range of vision are more involved in the game (each $p<0.05$).

The fact that subjects playing Virtuafighter with a wider range of vision are more involved in the game suggests that "literacy," or a kind of media susceptibility, is also the key to effectively realizing VR. It is notable that the media-susceptible subjects' contact with comics and magazines is significantly high ($p<0.5$). Thus, the ability to browse may be related to one's capacity to be media-susceptible. Further studies are needed in this area.

5. Discussion and Future Works

The above analysis suggests the following results.

• Video games, including VF, have little influences on personality as regards aggressiveness, extroversion, inferiority, progressiveness, sympathy.

• Video game (including VF) experiences are correlated to certain media activities.

• VF as a VR game is no different from ordinary video games in the personal influences analyzed here.

• It is uncertain whether players are subjectively immersed into games' environments in proportion to the games' realism.

• Players are not involved in games in proportion to the games' realism.

• Immersion into a game's environments does not necessarily cause involvement in the games and *vice versa*.

• Players who do not become immersed in VF environments become significantly more involved, and such players read more comic strips and magazines than other players.

The last finding suggests that cognitive processes relating VR games are not identical to those of real environments. Thus, cognitive properties of VR applications could have influences at a cognitive level. Moreover, the cognitive process bears relationship to susceptibility to other media.

The above analysis cannot show conclusively the influences of VR video games, but it suggests the possibility that some influences of VR cannot be controlled. Future studies should consider those influences.

6. Acknowledgment

This research was supported in part by the Japanese Ministry of Education, Science and Culture Grans-in-Aid for Scientific Research [07244101]. Thanks are due to Dr.Kazuhiro Ueda for valuable comments and criticisms from the viewpoint of cognitive science. Even so, there will be mistakes of interpretation for which the authors alone are responsible.

7. References

[1] Baba Y.; Takai S.; Oda Y.; Shirabe M., 'Assessment of personal and social impacts of virtual reality technology', The 1995's Report of The Fundamental Study on Virtual Reality, 1996, 101-102 (in Japanese).

[2] Baudrillard, J., *La Guerre du golfe n'a pas eu lieu*, Editions Galilée, 1991.

[3] Ford Morie, J., 'Inspiring the future: Merging mass communication, art, entertainment and virtual

environment', Computer Graphics, vol.28 no.2, 1994, 135-138.

[4] Goslin, M.; Ford Morie, J., 'Virtopia: Emotional experiences in virtual environments', Leonardo, vol.9 no.2, 1996, 95-100.

[5] Hashimoto, Y., 'Informatization and children's health（情報化と子供の心身）', in "Changing media and social lives（変わるメディアと社会生活）", Minerva（ミネルヴァ書房）, 1996, 150-170 (in Japanese).

[6] Latham, R., 'If VR is great, why are VR entertainment systems so poor? ', Computer Graphics, vol.28 no.2, 1994, 113-114.

[7] Newby, G., 'Virtual reality and the entertainment industry', Bulletin of the American Society for Information Science, vol.21 no.1, 1994, 20-21.

[8] Newell, A., *Unified Theories of Cognition*, Harvard University Press, 1990.

[9] Sakamoto, A., 'Is it true that video games have bad influences? （「テレビゲームの悪影響」は本当か？）', L'ESPRIT D'AUJOUDRD'HUI, no.312, 1993, 69-82 (in Japanese).

[10] Schroeder, R., *Possible Worlds*, Westview Press, 1996.

[11] Shirabe, M., 'Acceralation of progress in technology', in Shirabe, M. *et al.* "*Science, Technology and Societies*", Hokujyu（北樹出版）', now printing (in Japanese).

[12] Shirabe, M.; Baba, Y., 'Acceptance of virtual reality technology in video games', a paper in proceedings of Joint Conference of 4S & EASST, 1996.

[13] Sherman, W.; Craig, A., 'Literacy in virtual reality: a new medium', Computer Graphics, vol.29 no.4, 1995, 37-42.

[14] Templeman, M., 'To boldly go (virtual reality)', Computer Bulletin, vol.5 pt.5, 1994, 18-20.

[15] Yanai, H.; Kashiwagi, S.; Kokusho, R., 1987, Construction of a new personality inventory by means of factor analysis based on Promax rotation, The Japanese Journal of Psychology, vol.58 no.3, 158-165 (in Japanese).

[16] Yoshii, H., *Informatization and modern society（情報化と現代社会）*, Hokujyu（北樹出版）, 1996 (in Japanese).