VIRTUAL REALITY FOR ASSESSING BODY IMAGE: THE BODY IMAGE VIRTUAL REALITY SCALE (BIVRS)

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ABSTRACT

BIVRS, Body Image Virtual Reality Scale, is a prototype of a diagnostic freeware tool designed to assess cognitive and affective components of body image. It consists of a non- immersive 3D graphical interface through which the patient is able to choose between 7 figures which vary in size from underweight to overweight. The software was developed in two architectures, the first (A) running on a single user desktop computer equipped with a standard virtual reality development software, and the second (B) split into a server (B1) accessible via Internet and actually running the same virtual ambient as in (A), and a VRML client (B2) so that anyone can access the application.

The importance of a virtual reality based body image scale relies on the possibility to rapidly test one's perceived body image in better and different ways. It also provides an opportunity to easily develop a trans-cultural database on body image data. Furthermore, the possibility of using 3D can improve the effectiveness of the test because it is easier for the subject to perceive the differences between the various proposed silhouettes.

1. Body image disturbances

Concern with body size and shape has become very common in western society, particularly among females. During the last fifteen years many studies have clearly documented the prevalence of body image disturbances in non eating disorders subjects [Cash, Winstead and Janda, 1986], [Wardle and Beales, 1986], [Wooley and Wooley, 1984].

Rodin and colleagues have noted that women's concern with weight and body image has reached such proportions that "it can be considered a normal part of female experience" [Silberstein et al., 1987, p. 89]. They even coined the phrase "normative discontent" [Rodin et al., 1985, p. 267] to describe the pervasiveness of the problem. Indeed, they view this normative discontent with body image as existing in a continuum. Individuals at the extreme end of the scale have an elevated risk for developing eating disorders [Thompson, 1990].

In fact, research has definitively proved that a major role is played by body image dissatisfaction and, more generally, body image disturbance in patients with eating disorders. According to DSM-IV, the diagnostic manual of the American Psychiatric Association [DSM-IV,1994], the presence of alterations in body image should be considered as one of the criteria necessary for a diagnosis of mental anorexia and as one of the symptoms of bulimia nervosa. A large number of studies have highlighted the fact that the perception of one's own body and the experiences associated with it represent one of the fundamental problems of anorexic, bulimic and obese subjects [Bruch, 1962], [Stunkard & Mendelson, 1962], [Garfinkel & Garner, 1982], [Barrios et al., 1989], the effects of which can have repercussions on therapy regardless of the adopted therapeutic technique [Rosen, 1990]. Some studies concerning the efficacy of the cognitive-behavioral treatment of anorexia have indicated that patients who make a larger overestimate of their own bodily dimensions [Casper et al., 1979], or who are more pleased with their own physical appearance [Vandereychken et al., 1988], gain less weight after a period of treatment. Furthermore, among those who manage to reach their target weight, post-treatment weight loss correlates directly with the way in which patients perceive their own size [Button, 1986].

Also in the treatment of bulimic subjects, body values have been shown to play an important role in determining the outcome of treatment. In particular, the degree of satisfaction that patients have in relation to their bodies has been shown to be related both to a reduction in bulimic behavior and to subsequent relapses [Conners et al., 1984], [Freeman et al., 1985].

2. Assessment of body image

The construction of measurement procedures for the assessment of body image has proliferated in the recent years [Thompson, 1990]. Generally, researchers and clinicians have focused on two aspects of body image: a perceptual component, commonly referred to as "size perception accuracy", and a subjective component which entails aspects such as body size/weight and physical appearance [Cash & Brown, 1987].

There are two broad categories of procedures used for the assessment of size perception accuracy [Thompson, 1990]: body-site and whole-image procedures. Body-site estimation procedures require that subjects match the width of the distance between two points to their own estimation of the width of a specific body site. For instance, Slade and Russell [Slade & Russell, 1973] constructed the movable caliper technique (MCT), which consisted of a horizontal bar with two lights mounted onto a track. The subject could adjust the width between the two lights to match her/his estimate of the width of a given body site. The comparison of estimations with actual body widths, measured with body calipers, was used to derive a percentage of over- or under-estimation.

For these and other size estimation procedures, an assessment of the subject's actual width (measured with body calipers) is compared with the subject's estimate, and a ratio of over- or under-estimation of size is computed. Generally, the great majority of subjects overestimate all body sites; however, some data suggests that the waist is overestimated to the greatest degree [Thompson & Spana, 1988]. Because the estimates of the sites are highly correlated, some researchers sum across sites, giving a generic index of overestimation. It may be advisable, given the experimental or clinical purpose of the assessment, however, to evaluate each estimation site individually.

The whole-image adjustment methods constitute a second major category of size estimation procedures. With these procedures, the individual is confronted with a real-life image, presented via videotape, photographic image, or mirror feedback. The experiment is able to modify the representation to make it objectively smaller or larger than reality. The measure of perceptual inaccuracy is the degree of discrepancy between the actual real-life image and the one selected by the subject.

The schematic figures or silhouettes of different body sizes are the most widely used measure for the assessment of subjective components of body image disturbance [Fallon & Rozin, 198], [Thompson & Psaltis, 1988], [Thompson, 1990]. With this methodology, subjects are asked to choose the figures that they think reflect their current and their ideal body sizes. The discrepancy between these two measures is taken as an indication of level of dissatisfaction. A recent technical improvement of the figural/schematic rating procedure involves the presentation of body schemas on a computer screen [Dickson- Parnell, Jones, & Braddy, 1987]. With this method, subjects can adjust the sizes of nine body sites to arrive at the exact image representation that they believe fits their own dimensions. Again, a measure of generic satisfaction with the body can be obtained by asking subjects to create an ideal to compare with their selection of their own current image. A computer based test was also presented by Schlundt and Bell [Schlundt & Bell, 1988]. They have developed a microcomputer program for assessing cognitive and affective components of body image called the Body Image Testing Systems (BITS). The program, that is written in Turbo Pascal language for IBM PC, generates frontal view and side view silhouettes of a human body. Subjects can make the body silhouette image grow smaller or larger for nine independent body regions via the computer control system.

3. The Virtual Reality Modeling Language

The Virtual Reality Modeling Language (VRML) is a "language for describing multi-participant interactive simulationsvirtual worlds networked via the global Internet and hyperlinked with the World Wide Web" [Pesce, 1995]. All aspects of virtual world display, interaction, and internet working can be specified using VRML.

The first version of VRML (1.0) allowed for the creation of virtual worlds with limited interactive behavior. These worlds can contain objects that have hyperlinks to other worlds, HTML documents, or other valid Multimedia Internet Mail Extensions (MIME) types. The second version of VRML (2.0), available now, allow the user for richer behaviors, including animations, motion physics, and real-time multiuser interaction.

The first step in viewing a VRML document is retrieving the document itself. The document request comes from a Web browser-either a VRML browser or an HTML browser. Users send their request to the Web browser, and the Web browser sends the request on to its intended recipient. The Web server that receives the request for a VRML document attempts to fulfill the request with a reply. This reply goes back to the VRML browser [Pesce, 1995].

Once the document has been received by the VRML browser, it's read and understood by it creating visible representations of the objects described in the document. Each VRML scene has a "point of view", which is called a camera: you see the scene through the eye of the camera. It's also possible to predefine view points. All browsers feature some interface for navigation, so that you can move the scene's camera throughout the world.

A VRML world can be distributed-that is, it can be spread across the Web in many different places. In the same way that an Internet Web page can be composed of text from one place and images from another, a VRML world can specify that some of its scene comes from this place, while other objects come from that place.

This means that VRML files often load in stages; first the basic scene description is loaded, and then-if this refers to nested (scene within a scene) descriptions-the browser loads these after the basic scene has been loaded. Computer speeds aren't ever quite as fast as we would like, and neither are modems quite as capable as the demands we make upon them. For this reason, there is almost always some delay involved in loading a VRML world-it rarely appears immediately, or all at once. Links in VRML work in precisely the same way as they do within text pages.

VRML has the ability to show you where objects will appear before they've been downloaded. Before the object appears, it's shown as an empty box of the correct dimension (called a bounding box), which is replaced by the actual object when it has read in. Called lazy loading, it allows the VRML browser to take its time-when it has no other choice, that is-loading the scene from several different places while still giving you an accurate indication of what the scene will look like when it's fully loaded (Pesce, 1995).

4. The research project

The above considerations have led to the design of the following research protocol:

4.1 OBJECTIVES

The main aim of this research is the development of a virtual reality based body image assessment technique: BIVRS - Body Image Virtual Reality Scale. BIVRS is a software consistent of a non-immersive 3D graphical interface through which the patient is able to choose between 7 figures of different size which vary from underweight to overweight. Subjects are asked to choose the figures that they think reflect their current and their ideal body sizes. The discrepancy between these two measures is an indication of their level of dissatisfaction.

The software was developed in both of two architectures, the first (A) running on a single user desktop computer equipped with a virtual reality development software, such as Vream or Superscape, and the second (B) split into a server (B1) accessible via Internet and actually running the same virtual environment as in (A) and a VRML client (B2) chosen between the ones available for free in many Internet sites, so that anyone can access the application.

The reasons why we propose a Body Image Virtual Reality Scale are various. First of all, even though it is by now possible to choose between a wide range of different tests for the assessment of body image, we are still far from a culture free form, since every research is usually carried out in just one or two institutions, and in perfect isolation from the rest of the world. BIVRS, being designed to both run on any local desktop computer and on the Internet in VRML format, would soon provide a powerful tool to quickly standardize its results, e.g. by an immediate feedback given on-line right after the assessment session. This way, we could rapidly raise an international multi- cultural database, susceptible of further data splitting, when needed.

The second reason for the BIVRS to be developed is that virtual reality can add the third dimension to the body size silhouettes presented in the test, so improving its effectiveness. Using 3D it is easier for the subject to perceive the differences between the silhouettes, especially for specific body areas (breasts, stomach, hips and thighs).

A third reason, finally, is the extremely low cost of the system, where related to the costs of either a traditional assessment or a computer assisted assessment developed to run on machines other than small personal computers.

4.2 POPULATION

Initially BIVRS will be submitted to a sample of Italian normal (200 subjects) and clinical subjects (30 obese, 30 bulimic and 30 anorectic subjects). Other subjects, from different countries will be then added to the original sample. The subject submitted to BIVRS will be also submitted to other body image self-report scales in order to investigate the correlation between them.

4.3 SYSTEM DESIGN AND IMPLEMENTATION

BIVRS was developed using a Pentium based PC (166mhz, 32 mega RAM, graphic engine: Diamond Stealth 64 S3/964 4Mb VRam) and a Power PC based Macintosh (PPC 604, 120mhz, 32 mega RAM).

4.31 The development system

We developed the two sets of seven silhouettes using the Fractal Design Poser software for Macintosh. Poser is a 3D modelling software through which it is possible to easily build virtual objects, and particularly objects representing human bodies. Its purpose is then to provide, given some basic data about the dimensions of specific body sites, a ready-to-use object to be included in any virtual environment.

The two sets of figures, were first developed in wireframed mode to obtain precisely graduated increments between adjacent sizes. Using this mode it was possible to create seven female (Figures 1, 2, 3, the latter two only on the CD-ROM) and seven male (Figures 4, 5, 6, the latter two only on the CD-ROM) schematic figures that range from underweight to overweight.

Both the female and the male sets were then rendered and pre-tested (Figures

7, 8). The final sets, composed by more than 10,000 polygons, were then exported as .dxf files and converted in the VRML standard using the WCTV2POV.EXE program. This program is a freeware file converter, developed by Keith Rule for the Windows environment, that converts 3D DXF models in VRML 1.0 files. The final VRML files, {{femalset.wrl}} and {{maleset.wrl}} were then tested using Netscape 3.1 for Windows 95.

4.32 Motion input system

We have considered two different input systems, based on the specific module running, the single user station application (A) or the VRML client-server application (B).

4.321 Single user station module

The data glove-type motion input device is very common in virtual environments for its ability of sensing many degrees of freedom simultaneously. However, the problem with such devices is that the operator is also frequently confused for the difficulty in correctly using it, especially when there is a time delay contained in the feed-back loop.

To provide a easy way of motion in BIVRS we used an infrared two-button joystick-type input device: pressing the upper button the operator moves forward, pressing the lower button the operator moves backwards. The direction of the movement is given by the rotation of the operator's head. The loss of accuracy is thus compensated by the high usability, which is one of the main goals of our project.

4.322 VRML module

As for the VRML module, there is no other choice available than using the habitual keyboard as an input device. The importance to spread in any available way the assessment system all over the net to quickly and neatly standardize the results has already been discussed. We believe that as Internet clients grow more and more sophisticated, together with technology becoming more easily available, it should be possible, in a couple of years, to support better input devices on the VRML version too, thus making it not anymore necessary to keep two separated modules.

5. Conclusions

The importance of a virtual reality based body image scale relies on the possibility to rapidly test in better and different ways one's perceived body image. It also gives a chance to easily raise a trans-cultural database on body image data.

We have discussed the importance of virtual reality for the possibility of adding the third dimension to the body size silhouettes presented in the test: using 3D can improve the effectiveness of the test because it is easier for the subject to perceive the differences between the silhouettes, especially for specific body areas (breasts, stomach, hips and thighs). We have also noted that such system should become very important for the standardization of body image assessment data, because of the extremely high diffusion of the Internet in several different countries.

We have also set up a stand alone version, which could run on any low cost personal computer. In this system it is possible to provide a better input device, based on an infrared joystick and on a low cost head mounted display. We plan to export this solution to the VRML version too, as soon as such input devices will be supported on the net.

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{{Return}}

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{{Return}}

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{{Return}}

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{{Return}}

Beginning Previous Next Contents