Promoting Exercise Self-Efficacy With an Exergame

HAYEON SONG
Department of Communication, University of Wisconsin at Milwaukee, Milwaukee, Wisconsin, USA

WEI PENG
Department of Telecommunication, Michigan State University, East Lansing, Michigan, USA

KWAN MIN LEE
Annenberg School for Communication, University of Southern California, Los Angeles, California, USA and World Class University Professor, Department of Interaction Science, Sungkyunkwan University, Seoul, Republic of Korea

A new generation of exercise video games (exergames) shows promise as a tool to motivate and engage users in physical activity. However, little research has been conducted to examine whether exergames work equally well across diverse populations and contexts. Therefore, in the present study, the authors investigated the effects of an individual psychological difference factor and a specific contextual factor on the exercise experience using an exergame. They used the objective self-awareness theory as the theoretical underpinning. In a 2 (seeing the image of self on screen: seeing oneself vs. not seeing oneself) × 2 (body image dissatisfaction: low vs. high) between-subjects design experiment, the authors found significant interaction effects showing that the feature of seeing the image of self on screen provided by the exergame works positively for individuals with low body image dissatisfaction, yet works negatively for individuals with high body image dissatisfaction. The finding of the present study has significant implications for health professionals and individuals who use the new generation of exergames for physical activities.

More than 30% of Americans are obese (Ogden et al., 2006) and 48% of the children ages 6 through 19 years are at risk of becoming overweight or obese (Hedley et al., 2004). Lack of physical activity and consumption of an unhealthy diet are the two primary contributing factors to obesity and weight problems (Centers for Disease Control and Prevention, 2008). Less than 30% of U.S. adults ages 18 years and older engage in regular leisure-time physical activity (Barnes, 2007) as recommended by the U.S. Department of Health and Human Services guidelines. Screen time—the
amount of time spent in front of television or computer monitors—has been positively linked to a sedentary lifestyle (Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpelä, 2005; Robinson & Borzekowski, 2006). Once considered as a sedentary medium contributing to sedentary lifestyles and obesity (Vandewater, Shim, & Caplovitz, 2004), a new generation of video games requiring actual human body movements for interaction (exergames) are increasingly being used to promote physical activity (Maddison et al., 2007; Maloney et al., 2008; McDougall & Duncan, 2008; Mhurchu et al., 2008; Ridley & Olds, 2001; Tan, Aziz, Chua, & Teh, 2002; Unnithan, Houser, & Fernhall, 2006). Many applications of exergames are available, including Dance Dance Revolution (Konami), Play Station 2 EyeToy Kinetics (Sony), Wii Fit (Nintendo), and In the Groove (RedOctane). Exergames have been implemented in community centers, hospitals, and schools (Schiesel, 2007) as an innovative and motivating means to promote physical activity. Personal testimonials from players who have lost weight can also be found at many fan sites such as getupmove.com.

Although the popularity of exergames and the enthusiasm of exergame players have been recognized, there is a dearth of supporting research evidence to assess the effectiveness of using exergames to motivate users to engage in physical activities. Among the extant literature on exergames, limited research is available to provide a complete picture of the circumstances or conditions that promote their effectiveness. This situation potentially limits the scope of using exergames to promote physical activity on a broader scale. For example, few studies have examined whether exergames work equally well across diverse populations. It may be true that people who are already physically active can take advantage of exergames and receive physical benefits while enjoying the activities. Will exergames work equally well for people who are not active, though? Do the features of the exergames afford exercise motivation or factors affecting exercise (e.g., exercise self-efficacy) for less active people? In addition, among those exergames available on the market, most either include avatars to represent players in the virtual exercise environments (e.g., Wii Fit) or enable users to see their virtual selves on screen (e.g., EyeToy). Will this feature enhance the capacity of the exergames to motivate players or will it actually have a boomerang effect, especially for users with body image concerns? Using one of the most popular exergames, EyeToy Kinetics, we intended to empirically test whether the exergames promote exercise self-efficacy and whether they work equally well for users with different levels of body image concerns.

**Literature Review**

**Exercise Self-Efficacy**

Self-efficacy, defined as “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 3), is one of the most widely researched concepts in health promotion. In the domain of exercise and physical activity, exercise self-efficacy has been established as both the determinant and a consequence of physical activity participation (McAuley & Blissmer, 2000). Numerous empirical studies have shown self-efficacy to be a significant predictor of adoption of exercise and exercise adherence (Oman & King, 1998). Changes in efficacy over time corresponded with changes in exercise behavior. The determinant role of self-efficacy has been examined in both formal supervised

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**Promoting Exercise Self-Efficacy**

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activity and home-based programs across diverse populations (King et al., 1992; McAuley, 1993; McAuley, Courneya, Rudolph, & Lox, 1994; Trost, Kerr, Ward, & Pate, 2001). Because self-efficacy has been shown to be the mediating variable for actual behavior change in many physical activity intervention studies (Baranowski, Anderson, & Carmack, 1998), it is assumed that the first step in a successful physical activity promotion program is to increase exercise self-efficacy, which has also been established as the consequence of engaging in physical activity. Acute and chronic exercise experiences act as sources of efficacy (McAuley, Lox, & Duncan, 1993). In short, success in adopting and maintaining regular exercise depends largely on the individual’s self-efficacy.

Influencing Factors for the Effects of Exergames

It is necessary to examine which variables determine the effects of exergames, because these variables may yield additional information about context and circumstances that could heighten the benefits of these technologies. Psychological variables associated with weight status (e.g., body image perception, body image dissatisfaction) might play a role. To promote physical activities among inactive people, researchers have identified body image dissatisfaction as one of the major barriers. For example, Ball, Crawford, and Owen (2000) argued that the most significant barriers for obese people were their body image perception and laziness in doing exercise. It was found that “feeling too fat to exercise” is a common barrier for the overweight, particularly women. It is interesting to note that a recent study based on data from the 2002 National Physical Activity and Weight Loss Survey found that body size satisfaction had a significant effect on whether a person performed regular physical activity, regardless of the individual’s actual weight (Kruger, Lee, Ainsworth, & Macera, 2008). That is, those who were satisfied with their body size were more likely to engage in physical activity regularly than those less satisfied.

It is also important to consider the particular features of exergames. The literature on exercise psychology has shown that the environment of the exercise venue plays a significant role. For instance, exercising in a mirrored environment has different effects for different people (Katula & McAuley, 2001; Martin-Ginis, Jung, & Gauvin, 2003). Exercising in front of a mirror is more motivating for physically active people but less motivating for sedentary people. It is suggested that sedentary people have high body image dissatisfaction, and the mirror evokes the negative affect during exercise. During exergame use, the exercise environment includes both the physical environment around the player and the mediated environment on screen. Many recent exergames include avatars (e.g., Wii Fit) or projected images of self (e.g., EyeToy) on screen for the player to observe, which creating an environment similar to the mirrored one. Because the mirrored environment has different effects for different individuals, it is important to examine empirically whether the exergame feature that includes self-presentations or self-images on screen affects individuals differently. Answering this question is essential not only for exergame designers but also for health professionals and users who want to use exergames to promote physical activity. Therefore, we investigated the interaction effects of an individual psychological variable (body image dissatisfaction) and an exergame feature (seeing oneself on screen or not using EyeToy). The objective self-awareness theory was adopted as the theoretical framework for this study.
Related Theory

One of the well-known theories explaining the effect of seeing oneself in a mirror is the objective self-awareness theory. Duval and Wicklund (1972) defined self-awareness as the capacity to become the object of one's attention. An individual tends to experience self-awareness when attention is gravitating toward the self. There are two types of self-awareness: public and private (Carver & Scheier, 1981). Public self-awareness refers to the awareness of oneself from the imagined perspective of others, whereas private self-awareness indicates the awareness of oneself from a personal perspective.

The objective self-awareness theory focuses on the effect of private self-awareness, which is commonly manipulated by seeing oneself in a large mirror (Bushman & Sentyrz, 1998; Dijksterhuis & van Knippenberg, 2000; Mullen, Migdal, & Rozell, 2003; Philips & Silvia, 2005). The main premise of the theory is that self-awareness, a state of attention focused on the self, induces self-evaluation whereby an individual compares the self and the standards that are salient in the context. When an individual finds that the self is congruent with the standards, self-awareness leads to a positive affect (Duval & Silvia, 2001, 2002; Scheier & Carver, 1980). For instance, self-awareness after success further heightens self-esteem (Duval & Silvia, 2002). In contrast, a negative affect can occur when there is a discrepancy between the perception of the self and a set of standards (Fejfar & Hoyle, 2000; Mor & Winquist, 2002). A study conducted by Phillips and Silvia (2005) showed that when self-awareness was low (i.e., not seeing oneself in the mirror), self-discrepancies had a nonsignificant association with emotion, yet when self-awareness was high (i.e., seeing oneself in the mirror), self-discrepancies strongly predicted emotion. Self-awareness can thus be interpreted as increasing the accessibility of disparities between the self and the standards (Gibbons, 1990; Hormuth, 1982; Sedikides, 1992) and making the discrepancy more salient (Duval & Silvia, 2001, 2002), resulting in a situation that leads to negative emotions (Higgins, 1987).

Empirical studies show that self-evaluation elicited by self-awareness has different or even opposite effects for various individuals (for the review, see Fejfar & Hoyle, 2000). For instance, Katula and McAuley’s (2001) study using highly active women found that exercising in the mirrored environment had a positive effect on exercise self-efficacy. That is, only in the with-mirror condition did exercise self-efficacy increase in posttests; there was no significant difference between pre and posttests in the no-mirror condition. In contrast, a study with 58 sedentary women (Martin-Ginis et al., 2003) showed a negative effect of exercising in front of the mirror on positive mood change. That is, those participants in the with-mirror condition felt significantly worse than did those in the no-mirror condition. Another study targeting moderately active men and women (Katula, McAuley, Mihalko, & Bane, 1998) found a significant interaction effect between gender and exercise settings (mirrored lab, un-mirrored lab, and natural setting): Women had significantly lower exercise self-efficacy than did men in the mirrored condition. That study’s hierarchical regression analysis showed interesting results about social physique anxiety—the anxiety experienced when one worries about how one’s body image is perceived and evaluated by other people. Only in the mirrored condition was social physique anxiety a significant predictor of exercise self-efficacy. It was speculated that seeing oneself during exercise enhanced individuals’ self-focus, making body image concerns more salient, resulting in reduction of efficacy in the female participants. Similarly,
Crawford and Eklund (1994) also illustrated that social physique anxiety is one of the most important factors explaining exercise-related outcomes. They found opposite preferences for individuals with high versus low social physique anxiety; individuals with high levels of social physique anxiety reported preferences for exercise environment and clothing that distress the body image, whereas individuals with low social physique anxiety preferred the opposite.

To provide more evidence to identify the moderating variable for the effect of self-awareness resulting from seeing one’s own image, the present study tests the effect of body image dissatisfaction and seeing oneself during exercise on exercise experiences. Because seeing the image of self captured by a webcam (Joinson, 2001; Yao & Flanagin, 2006), or even a similar image of self, can enhance self-awareness (Vasalou, Joinson, & Pitt, 2007), we expect that seeing oneself on screen using the EyeToy camera may increase self-awareness. Among those who have positive body images, we hypothesize that playing an exergame in the seeing-oneself condition will result in (a) higher exercise self-efficacy, (b) more positive mood, and (c) greater enjoyment than those in the not-seeing-oneself condition. In contrast, an opposite pattern will be observed among those who are not satisfied with their body images, that is, individuals who play an exergame in the not-seeing-oneself condition will have a better exercise experience than those in the seeing-oneself condition. To examine whether the EyeToy exergame is a motivating tool for physical activity, we also explored how participants with different levels of body image satisfaction evaluate the EyeToy exergame and their buying intentions.

Method

Participants

The experiment used a 2 (seeing the image of self on screen: seeing oneself vs. not seeing oneself) × 2 (body image dissatisfaction: low vs. high) between-subjects design. In total, 198 college students were recruited from a West Coast university. Upon their agreement to participate in the study, participants were asked to fill out an online questionnaire containing a screening test. On the basis of distribution of the body image dissatisfaction score in the screening test, only those who were in the upper 30% (score range = 1.0–4.0) and below 30% (score range = 6.0–10.0) were chosen. The average body image dissatisfaction score was 2.83 (SD = 0.88) in the low condition and 7.14 (SD = 1.03) in the high condition, t(83) = 20.61, p < .0001. The remaining 40% of the participants whose body image dissatisfaction scores fell into the middle range (i.e., from 4.01 to 5.99) were thanked and asked to terminate the study; they were told in the recruitment process that the study required a specific population meeting a certain criterion for the purpose of the research. Regardless of participation in the main study, all the individuals who finished the screening test were given extra class credits.

Among the 90 people invited to the lab, 85 showed up and completed the study (60 women and 25 men). Each qualified individual was then randomly assigned to either the seeing-oneself condition or the not-seeing-oneself condition and played the PlayStation 2, EyeToy Kinetics (Sony) exergame. Thirteen men and 29 women were in the seeing-oneself condition wherein they exercised using the EyeToy exergame while seeing their own images on screen, whereas 12 men and 31 women were in the not-seeing-oneself condition. Among the women, 20 had low body
dissatisfaction and 40 had high body image dissatisfaction. Among the men, 19 were in the low body dissatisfaction condition and 6 in the high body image dissatisfaction.

Procedure
At least 2 weeks after the screening test, the chosen participants were invited to a lab. In an invitation email, they were instructed to wear or bring comfortable clothes and shoes for exercise. Upon arrival, individuals filled out a consent form and did a moderate level of exercise for 20 min by playing EyeToy Kinetic. As one of the most advanced exergames, EyeToy Kinetic provides its users with an opportunity to exercise following a virtual trainer, while seeing themselves on the screen. It uses a digital camera to capture the image and motion of the player and projects that on the screen.

In the seeing-oneself condition, participants could see their own images on the right side of the screen. On the left side of the screen, a virtual trainer demonstrated how to do the leg exercise. For the not-seeing-oneself condition, the webcam was blocked with black paper so that the participants’ images could not be projected on the screen. Participants in this condition could only see the virtual trainer on the screen.

Measures
For details of measures, see Table 1.

Results
The body mass index data indicated that one participant was underweight (body mass index = 16.76), 71 were of normal weight (body mass index: $M = 21.33$, $SD = 1.80$), and 13 were overweight (body mass index: $M = 27.63$, $SD = 1.79$). The average score of general exercise self-efficacy was 6.37 ($SD = 1.74$). The median of exercise time per week was 180.0 min for vigorous ($SD = 194.1$), 180.0 min for moderate ($SD = 170.6$), and 120.0 min for mild exercise ($SD = 183.1$). The $t$ test results showed that the manipulation was successful: Self-awareness was significantly lower in the not-seeing-oneself condition ($M = 3.91$, $SD = 1.77$) than in the seeing-oneself ($M = 4.61$, $SD = 1.37$), $t(83) = 3.45$, $p < .05$.

To test the hypotheses, we conducted analyses of covariance. The covariate variables were (a) general exercise self-efficacy measured before the experiment, (b) body mass index measure calculated by participant’s weight and height, (c) exercise time, and (d) gender.

We found a significant interaction effect for exercise self-efficacy of using EyeToy, $F(1, 77) = 5.83$, $p < .05$, $\eta^2 = .07$ (see Figure 1a and Table 2). Among those who were not satisfied with their body images, seeing their images on screen resulted in lower exercise self-efficacy ($M = 4.81$, $SD = 1.40$) than did not seeing oneself ($M = 6.21$, $SD = 1.33$). For participants who liked their body images (low body image dissatisfaction), there was no significant difference between the seeing-oneself condition ($M = 5.78$, $SD = 1.43$) and the not-seeing-oneself condition ($M = 5.75$, $SD = 1.30$). Although we found no main effect of body image dissatisfaction, $F(1, 77) = .23$, $ns$, $\eta^2 = .003$, the main effect of seeing oneself on screen was found to be significant, $F(1, 77) = 6.24$, $p < .05$, $\eta^2 = .08$. When both the interaction effect and the main effect coexist, follow-up tests are usually needed to explore the exact nature.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Citation</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body image dissatisfaction (α = .81)</td>
<td>Garner, Olmstead, &amp; Polivy (1983)</td>
<td>10-point Likert-type scale (e.g., “I think that my stomach is too big.”)</td>
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<td>Self-awareness (α = .82)</td>
<td>Revised version of the private self-consciousness scale (Fenigstein, Scheier, &amp; Buss, 1975)</td>
<td>10-point Likert-type scale</td>
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<td>1) During the exercise, I was very aware of the way my mind works when I worked through the problem.</td>
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<td>2) During the exercise, I found myself paying attention to changes in my mood.</td>
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<td>3) During the exercise, I found myself attending to my inner feelings.</td>
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<td>4) During the exercise, I felt that I was trying to figure myself out.</td>
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<td>5) During the exercise, I felt that I was watching myself.</td>
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<td>Positive mood (α = .84)</td>
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<td>10-point Likert-type scale</td>
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<td></td>
<td></td>
<td>1) I feel refreshed after exercising with this game.</td>
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<td></td>
<td></td>
<td>2) I feel good after exercising with this game.</td>
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<tr>
<td></td>
<td></td>
<td>3) I feel bad after exercising with this game.</td>
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<tr>
<td></td>
<td></td>
<td>4) I feel happy after exercising with this game.</td>
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<tr>
<td></td>
<td></td>
<td>5) I feel positive after exercising with this game.</td>
</tr>
<tr>
<td>Exercise self-efficacy of using EyeToy (α = .74)</td>
<td>Revised version of the general exercise self-efficacy scale (Shin, Jang, &amp; Pender, 2001)</td>
<td>10-point Likert-type scale</td>
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<td></td>
<td></td>
<td>Respondents were asked to indicate their confidence of exercising with EyeToy in seven situations such as when they were feeling tired, or when they had too much work to do at home.</td>
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<tr>
<td>Enjoyment of the game (α = .78)</td>
<td></td>
<td>10-point Likert-type scale ranging from 1 (describes very poor) to 10 (describes very well) to rate how well those adjectives described their game playing experience</td>
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<td></td>
<td></td>
<td>6 adjectives were measured: enjoyable, entertaining, exciting, fun, interesting, and pleasant.</td>
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<tr>
<td>Evaluation of the EyeToy game ($\alpha = .93$)</td>
<td>10-point Likert-type scale ranging from 1 (<em>describes very poor</em>) to 10 (<em>describes very well</em>) to their attitudes towards the EyeToy game. 9 adjectives were measured: useful, good, enjoyable, beneficial, fun, interesting, pleasant, worthwhile, and helpful.</td>
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<tr>
<td>Buying intention ($\alpha = .96$)</td>
<td>10-point Likert-type scale ranging from 1 (<em>very unlikely</em>) to 10 (<em>very likely</em>) 1) How likely are you to purchase this exercise game? and 2) How likely are you to recommend this exercise game to others?</td>
<td></td>
</tr>
<tr>
<td>Liking the image of self on screen* ($\alpha = .96$)</td>
<td>10-point Likert-type scale 1) I like my image on screen. 2) I look good on screen. 3) I look pretty (handsome) on screen.</td>
<td></td>
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<tr>
<td>Liking to see myself on screen* ($\alpha = .91$)</td>
<td>10-point Likert-type scale 1) Seeing my own image on screen makes me feel good about myself. 2) I feel excited when I see my own image on screen. 3) I like seeing my own image on screen.</td>
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<tr>
<td>Exercise time**</td>
<td>Revised version of the Godin Leisure-Time Exercise Questionnaire (Godin &amp; Shephard, 1985) Calculated by adding all the time participants reported spending on vigorous (e.g., tennis, basketball), moderate (e.g., jogging, yoga), and mild (e.g., walking) exercise activities every week.</td>
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<td>General exercise self-efficacy**</td>
<td>Shin et al.’s (2001) 10-point Likert-type scale The original measure had three subfactors: 1) Situational/interpersonal 2) Competing demands 3) Internal feelings Only the internal feelings subfactor (7 items) was measured.</td>
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<tr>
<td>Body mass index**</td>
<td>Calculated on the basis of participants’ weight and height</td>
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</tbody>
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*Asked only in the seeing-oneself condition. **Included as covariates in data analysis.
of the interaction. The simple effect analysis revealed that the main effect of seeing oneself was only statistically significant in the high body dissatisfaction group, \(F(1, 81) = 12.11, p < .001\), and was not significant in the low body dissatisfaction group, \(F(1, 81) = .00, ns\). In other words, the effect of seeing oneself only existed on one level of the other independent variable (body image dissatisfaction).

There was a significant interaction effect of the two independent variables on positive mood, \(F(1, 77) = 11.00, p < .001, \eta^2 = .12\) (see Figure 1b). Among those who were satisfied with their body images, seeing oneself resulted in more positive mood (\(M = 7.81, SD = 1.09\)) than not seeing oneself (\(M = 7.34, SD = 1.21\)). In contrast, among those who disliked their body images (high body image dissatisfaction), not seeing oneself resulted in more positive mood (\(M = 7.81, SD = 1.36\)) than did seeing oneself (\(M = 6.45, SD = 1.21\)). Neither the main effect of body image

Table 2. Mean and standard deviation for each condition and interaction effect of independent variables on dependent variables

<table>
<thead>
<tr>
<th></th>
<th>Low body image dissatisfaction</th>
<th>High body image dissatisfaction</th>
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<tbody>
<tr>
<td></td>
<td>Not seeing oneself</td>
<td>Seeing oneself</td>
</tr>
<tr>
<td>Exercise self-efficacy</td>
<td>(M = 5.75, SD = 1.30)</td>
<td>(M = 5.78, SD = 1.43)</td>
</tr>
<tr>
<td>Positive mood</td>
<td>(M = 7.34, SD = 1.21)</td>
<td>(M = 7.81, SD = 1.09)</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>(M = 5.82, SD = 1.03)</td>
<td>(M = 6.83, SD = 1.09)</td>
</tr>
<tr>
<td>Evaluation</td>
<td>(M = 7.33, SD = 1.27)</td>
<td>(M = 7.90, SD = 0.85)</td>
</tr>
<tr>
<td>Buying intention</td>
<td>(M = 5.35, SD = 2.31)</td>
<td>(M = 6.51, SD = 1.36)</td>
</tr>
</tbody>
</table>

\(* p < .05. \ ** p < .01. \ *** p < .001.\)
dissatisfaction, $F(1, 77) = 2.21, ns, \eta^2 = .03$, nor the main effect of seeing oneself was significant, $F(1, 77) = 3.01, ns, \eta^2 = .04$.

Similarly, the interaction effect was significant for enjoyment, $F(1, 77) = 15.20, p < .001, \eta^2 = .16$ (see Figure 1c). Among those who were satisfied with their body images, seeing their self-images during exercise was more enjoyable ($M = 6.83, SD = 1.08$) than not seeing the images ($M = 5.82, SD = 1.03$). Conversely, seeing oneself on screen during exercise was not helpful for those who disliked their body images. Specifically, among those who disliked their body images, people in the not-seeing-self condition enjoyed the exercise ($M = 6.78, SD = 1.97$) more than did those in the seeing-self condition ($M = 5.37, SD = 1.34$). Neither the main effect of body image satisfaction, $F(1, 77) = .55, ns, \eta^2 = .007$, nor the main effect of seeing the image of self was significant, $F(1, 77) = .39, ns, \eta^2 = .005$. In summary, our hypotheses about the interaction effects of body image dissatisfaction and seeing oneself on screen on exercise self-efficacy, positive mood, and enjoyment were all supported.

We found significant interaction effects for evaluation of the EyeToy exergame, $F(1, 77) = 15.75, p < .001, \eta^2 = .16$, and buying intention, $F(1, 77) = 9.70, p < .01, \eta^2 = .11$. Specifically, participants who disliked their body images evaluated the EyeToy exergame more positively when they did not see their self-images ($M = 8.06, SD = 1.47$) than when they did ($M = 6.29, SD = 1.59$), whereas participants who liked their body images evaluated the EyeToy exergame more positively when they saw their self images ($M = 7.90, SD = .85$) than when they did not ($M = 7.33, SD = 1.27$). Similarly, participants who disliked their body images indicated greater intention to buy the EyeToy exergame when they did not see their self-images ($M = 6.13, SD = 2.83$) than when they did ($M = 4.19, SD = 2.24$), whereas participants who liked their body images evaluated the EyeToy exergame more positively when they saw their self-images ($M = 6.51, SD = 1.36$) than when they did not ($M = 5.35, SD = 2.31$).

In addition, a main effect of seeing the image of self was found regarding evaluation of the EyeToy exergame, $F(1, 77) = 4.44, p < .05, \eta^2 = .05$. The simple effect analysis indicated that the main effect of seeing the image of self on evaluation of the EyeToy game was only statistically significant in the high body image dissatisfaction group, $F(1, 81) = 19.64, p < .001$, and not significant in the low, $F(1, 81) = 1.65, ns$. Similarly, the main effect of body image dissatisfaction was found significant regarding buying intention, $F(1, 77) = 5.49, p < .05, \eta^2 = .07$. The simple effect analysis indicated that the main effect of seeing the image of self on evaluation of the EyeToy game was only statistically significant in the high body image dissatisfaction group, $F(1, 81) = 11.13, p < .001$, and not in the low, $F(1, 81) = 1.37, ns$.

For participants in the seeing-oneself condition, those with low body dissatisfaction ($M = 6.43, SD = 1.85$) indicated that they liked seeing the their self-images on the screen more than did those with high body dissatisfaction ($M = 3.03, SD = 1.90$), $t(40) = 5.84, p < .001$. Individuals with low body dissatisfaction ($M = 6.44, SD = 1.65$) also liked their self-images on the screen more than did those with high body dissatisfaction ($M = 2.58, SD = 1.75$), $t(40) = 7.29, p < .001$.

**Discussion**

This study empirically tested the effect of the specific contextual element of exercise and individual psychological differences. Specifically, this study examined how the
feature of seeing the image of self on a screen in the mediated environment of an exergame effects differently for individuals with varying levels of body image dissatisfaction. Interaction effects were significant on all the dependent variables—exercise self-efficacy using the exergame, positive mood after exercise, enjoyment, evaluation of the exergame, and buying intention.

Previous literature indicated mixed findings with regard to exercise in a mirrored environment (Katula & McAuley, 2001; Katula et al., 1998; Martin-Ginis et al., 2003). One explanation is that the samples were different: Some participants were physically active, and some were sedentary. Another explanation is that certain psychological variables such as body image concern could moderate the effects. In the present study, we used a sample of college students who were relatively active, and controlled several important variables that might influence the dependent variables: body mass index, exercise level, general exercise self-efficacy, and gender. None of the variables was found to be a significant covariate in the analysis of covariance model. Even when controlling for the potential covariates, the interaction effect of body image dissatisfaction and exercise environment was still found. In short, seeing oneself on a screen had a positive effect only among those who were satisfied with their body images. This result suggests that seeing oneself on a screen while exercising (one of the advanced features of recent exergames) is not helpful for everyone. Doing so actually may decrease exercise self-efficacy, positive mood, and enjoyment among those who have high body image concerns.

This finding has significant implications for health professionals who attempt to take advantage of the new generation of active video games to promote physical activities. Our finding suggests that a novel feature of the EyeToy game, projecting the user’s images and motions to interact in the game, actually has detrimental effects for people with high body image dissatisfaction as a result of the increased self-awareness of seeing oneself, a state that a negative affect by comparing the “imperfect” self with an ideal standard. A premise of the new generation of active video games is that they can reach sedentary population, or the overweight and obese population, to provide a novel and fun way to motivate them to engage in physical activities. Yet, it is likely that a projected image of the self on a screen may backfire instead. Seeing one’s far-from-perfect body exercising in an uncoordinated way on the screen is not motivating; rather, it is discouraging. This suggests that a more tailored design of exergames is needed to optimize the exercise experience for preexisting differences in the audience.

Our empirical findings may add to the dearth of literature about the effect of seeing oneself on a screen and extend the objective self-awareness theory to a new domain. In the current digital age, it is common to see oneself not only in the mirror but also in many technology-supported communication applications. For example, people constantly see their own images during teleconferencing, in instant messaging, and on social networking sites. Despite popular use of self-image with new communication technology applications, research concerning the image of self through new media is limited. Our study expands applicability of the objective self-awareness theory by examining the sociopsychological effects of seeing one’s own images through new media. In addition, we successfully included the manipulation check and empirically demonstrated that self-awareness can be induced by the image of self on screen, unlike most previous studies merely assuming that seeing oneself in a mirror would automatically induce self-awareness without including the manipulation check (see Fejfar & Hoyle, 2000).
Limitations and Future Research

There are some limitations in the study that should be addressed. First, this research included young adults, especially women who might be relatively more sensitive to body image than might any other population. It is unknown whether body image dissatisfaction has the same effects on psychological factors in the exercise experience for other age groups. Second, we tested only the effect of objective self-awareness in this study. However, there is another type: public. Public self-awareness, feeling being watched, related with psychological factors in exercise experience for social physique anxiety. The study took place in a lab rather than at home in private, which could possibly induce some level of public self-awareness so that participants felt more self-conscious. It would be interesting to examine the effect of group versus individual exercise setting.

Third, we treated gender as one of the covariates in order to test the unique effect of the independent variables. Thus, it is not clear how the mechanism of seeing oneself on screen differs between men and women. Previous literature suggests that women are generally more likely to have higher self-awareness (Fejfar & Hoyle, 2000) and body image dissatisfaction (Davis & Cowles, 1991) than men. Given the preexisting gender difference, future studies should reveal how the relations among self-awareness, body image satisfaction, and exercise self-efficacy differ between men and women. With this knowledge, exergames may ultimately provide a more optimized exercise environment for both genders.

Our study demonstrated that seeing the image of self on a screen could induce self-awareness and that seeing the image of self had positive effects for people with low body dissatisfaction and negative effects for those with high, in terms of their exercise self-efficacy using the exergame, mood, and enjoyment. Yet, we did not empirically test whether increased self-awareness led to comparison of oneself with the standard or the size of the self-standard discrepancy. In the present study, all participants observed a trainer with a fit body on the screen, regardless of the availability of self-image. It will be an intriguing question to explore whether the participants actually compare their own images with the image of this trainer.

In addition, screen size may be examined further to test the effect of seeing oneself on screen on self-awareness. Scheier and Carver (1980) used a small mirror to induce self-awareness and found that the effect of self-awareness significantly decreased. One may extrapolate that bigger screen size thus increases self-awareness more, since screen size has been found to have a significant psychological effects (Lee & Peng, 2003). In other words, the television monitor used to play the game might also play a significant role.

In conclusion, this study examined exercise self-efficacy from a multidisciplinary perspective, using an exergame. Given the fact that body image concerns were often reported as one of the barriers to going to a gym for exercise, using an exergame at home might be an attractive alternative, especially among individuals with high body image dissatisfaction. This study investigated how individuals may enjoy the full benefits of an exergame. The results suggested that individual differences such as body image satisfaction should be considered in designing the interface of video games to facilitate exercise. Video games have unique characteristics such as interactivity and maximized capacity of tailoring to the audience. We believe that with further investigation, exergames can provide the optimized exercise environment to individuals more efficiently than ever.
References


