

Women's Long-Term Reactions to Whole-Body Scanning: A Mixed Methods Approach

Professor Sarah Grogan, Department of Psychology, Manchester Metropolitan University, Birley Building, Bonsall Street, Manchester, UK, M15 6GX; s.grogan@mmu.ac.uk; telephone +44 161 247 2504 (**corresponding author**)

Dr Simeon Gill, School of Materials, The University of Manchester, Sackville Street,, Manchester, UK, M13 9PL; simeon.gill@manchester.ac.uk.

Dr Kathryn Brownbridge, Clothing Design Technology, Manchester Metropolitan University, Oxford Road, Manchester M15 6BH; k.brownbridge@mmu.ac.uk

Ms Dawn Warnock, Psychology Sport and Exercise, Staffordshire University, Leek Road, Stoke on Trent, UK, ST4 2DF; dawnywarn@me.com

Professor Christopher J. Armitage, Manchester Centre for Health Psychology, School of Psychological Sciences, Manchester Academic Health Science Centre, University of Manchester, Coupland Street, Manchester, UK, M13 9PL; chris.armitage@manchester.ac.uk.

**RUNNING HEAD: WOMEN'S LONG-TERM REACTIONS TO WHOLE-BODY
SCANNING**

doi: 10.1177/0887302X15603117 *Clothing and Textiles Research Journal* **September 7, 2015**

Women's Long-Term Reactions to Whole-Body Scanning: A Mixed Methods Approach

Whole-body scanning enables accurate and detailed assessment of the body by measuring surface topography, and it is used by those needing clear images of external body shape, including clothes industry technologists who seek to optimize garment fit (Istook, 2000). Most scanners use image capture and light sources to produce an accurate 3-dimensional (3D) image and a list of body measurements. Scan images provide a realistic 3D view of the body rendered from point cloud data taken from the body surface, so the image is a surface representation without discernible features. Although it is possible to view a photorealistic image, most scanners use some form of surface rendering such as the point cloud data shown in Figure 1. Scans offer people unique views of their bodies in three dimensions and from all possible angles (Loker, Ashdown, & Carnrite, 2008). Previous studies have tended to focus on the application of the scan data rather than soliciting participants' views on the experience of being scanned. Growth in 3D representation of the human form in virtual environments necessitates that we understand how being body scanned and viewing 3D images affects the people who are scanned. The aim of this study was to explore women's long-term reactions to being whole-body scanned.

[Insert Figure 1 About Here]

Whole-Body Scanning and Body Image

The process of being whole-body scanned usually involves people undressing to their underwear, being scanned in a small cubicle or curtained area, and then viewing either a detailed 3D screen image or a 2D printed version of their body data. The degree of body exposure involved during the scanning process, and in viewing the scan itself, might be expected to be a matter of concern for many women. In spite of cultural awareness of the need to reduce

objectification of women's bodies, there remains significant sociocultural pressure on women to be slender and toned (Frith, 2012; Tiggemann & Andrew, 2012); many women of all ages are dissatisfied with aspects of their bodies and most want to be slimmer (Grogan, Gill, Brownbridge, Kilgariff, & Whalley, 2013; Tiggemann & McCourt, 2013). For many women, and especially for those who are already dissatisfied with their bodies, getting and remaining undressed in a semi-public space may be a concern, even if a robe is employed when moving from changing cubicle to scanner. Also, looking at whole-body scans gives women access to a more comprehensive view of their bodies than is possible through looking in a mirror, and it has been shown that people in the USA and elsewhere perceive body scan images with lower body mass index (BMI, or weight relative to height) as more attractive than high-BMI body scan images (Aghekyan, Ulrich, & Connell, 2012).

One of the key psychological theories that might help us to understand women's experiences of being whole-body scanned is Objectification Theory (Fredrickson & Roberts, 1997). This approach focuses on the impact on women of existing in a culture that objectifies women's bodies. It suggests that existing in a sexually objectifying culture means that women may experience self-objectification at two levels: state self-objectification, which is where attention is drawn to women's bodies in particular contexts (such as when others comment on how they look or when they see their bodies in photographs), and trait self-objectification, which is where some women develop a chronic view of their body as an object, leading to habitual body monitoring, shame, and anxiety about their bodies; trait self-objectification has been linked with body dissatisfaction in women of all ages (Grippo & Hill, 2008). Although not linked directly in any published work to date, Objectification Theory would suggest that whole-body scanning would be likely to prime state self-objectification in most women, making them

temporarily more aware of how their bodies look. It would also suggest that for women who are more anxious about their bodies (those most likely to engage in trait self-objectification), scanning may be an additional source of information that is used to evaluate their bodies critically, leading to additional body dissatisfaction.

Women's Experiences of Whole-Body Scanning

Although body scanning is a process that has been widely used to gather important body measurement data to inform the development of sizing systems for the clothing industry (Bougourd, Dekker, Grant Ross, & Ward, 2000), there is very limited research on women's experiences of body scanning. However, Loker, Cowie, Ashdown, and Lewis (2004) surveyed 203 women aged 35-55 years after they had been body scanned and found that acceptance of body scanning among the group was high with 88% reporting feeling comfortable and 98% willing to be scanned again. Those with higher household incomes and those who were married reported lower comfort ratings. The authors also recorded responses to the scan process in a sub-sample of women as they were scanned. They found that although all 22 participants showed positive emotions such as smiling and head nodding, there were also signs of unease, and some made comments suggesting they were dissatisfied with the way that they looked on the scan, such as "I don't want anyone seeing it" and "I should put it on my fridge" (Loker et al., 2004; p. 158). No direct measures of BMI or body satisfaction were taken in these studies, so it is unclear how experience of scanning links to body satisfaction and BMI. However, the authors did find that women wearing smaller sizes of clothes were more comfortable when viewing their scanner images and in showing images to their family and friends than women wearing larger sizes. Clothing size did not predict comfort with the process of being scanned.

Studies focusing directly on links between body satisfaction and body scanning have revealed complex patterns of results. Domina, Herberger, and MacGillivray (2008) investigated women's willingness to be body scanned and found that neither body satisfaction nor self-esteem predicted willingness to be scanned. In this study of 85 women ages 18-25 who were on average in the overweight category (as determined by BMI), 86% chose an ideal body that was thinner than their perceived current figure, yet most were comfortable with being scanned and with viewing their scans. In another study, Grogan, Gill, Brownbridge, Kilgariff, and Whalley (2013) carried out in-depth interviews with 20 women who had been whole-body scanned. Women reported that they looked slimmer and more "in proportion" than they had expected, suggesting higher satisfaction levels as a result of scanning, contrary to what might be expected from Objectification Theory. Researchers studying body size estimation (Cornelissen, Johns, & Tovee, 2013) have shown that many women, particularly those with weight and shape concerns, tend to overestimate the size of their bodies. One possible explanation of Grogan et al.'s (2013) results is that showing women realistic images of their bodies in a whole-body scan reduced this overestimation, resulting in higher body satisfaction. However, we need to know more about experiences of being scanned in a larger and more varied group of women than in the Grogan et al. (2013) study, which accessed only women aged 18-45 with dress sizes between UK 10-14, and to look at longer-term responses that are provided anonymously rather than immediate reactions that are given face-to-face to an interviewer.

The Present Study

To date, the potential sustained effects of whole-body scanning on body satisfaction have not been explored. This is an important omission because as technology develops and body scanning becomes more widely used, it is crucial to ensure that scanning is done in ways that

protect women from the kinds of negative short- and long-term consequences that might be linked with self-objectification. Also, large-scale studies using samples varying in age and body mass index are needed to increase our understanding of how women of a variety of ages and sizes experience whole-body scanning. The aim of this study was to explore women's long-term reactions to being whole-body scanned. Women who had been whole-body scanned at fashion events in two clothes-technology studies conducted by the second and third authors, and who had agreed to take part in further research on body scanning, completed a retrospective online questionnaire. They responded to an open-ended question about their experiences and also completed some closed-ended questions on attitude toward being scanned, likelihood of being rescanned in the future, change in body satisfaction since being scanned, and on their current body satisfaction. The open-ended question was designed to enable us to gain a more in-depth understanding of responses to the closed-ended questions. These data were collected after participants had the opportunity to reflect on their experience, which allowed us to explore the possibility that body scanning offers people a new perspective on their bodies.

Research Questions

1. How do women feel about being whole-body scanned, and are these feelings linked with body satisfaction, age, and body mass index at time of scanning?
2. Do women report changes in body satisfaction after the scan?

Method

Participants

Four-hundred and fifty-six women who had been whole-body scanned in two clothes-technology studies carried out at fashion events in July and September 2013 were sent letters in October 2013. These women were selected to enable us to access a large number of women who had been body scanned using the TC2 KX-16 (TC2, 2011) scanner following established ethical protocols relating to privacy. Women had been scanned in their own underwear (to ensure an accurate silhouette) in a private scan cubicle, and their privacy was protected by a curtain while they were in the scanner. For ethical reasons, the scanner images were set at the TC2 default setting, which generates an image described as a point cloud. This was chosen purposefully over the photorealistic option available from a TC2 scanner in order to reduce the potential for embarrassment to participants. Letters asked the women to participate in a follow-up study, and included a link to an online questionnaire. Ninety-one women between 18 years and 81 years (average age 51 years) returned completed online questionnaires. Women ranged in BMI at time of scanning between 19 (normal weight) and 42 (obese) with an average BMI of 25 (slightly overweight; British Heart Foundation, 2015). Ethnicity was mostly white ($n = 80$; see Table 1). Compared with the parent population of 456 women who were originally scanned, women who completed the online survey were slightly older, and had a narrower range of BMI, age, and ethnicity than the total group (Table 1), but there were no significant differences in BMI ($t = .527, p = .600$) or age ($t = 1.03; p = .305$) between the study sample and the parent population.

[Table 1 about here]

Instrument Development

Open-ended question. Respondents were asked to respond in as much detail as possible to the question: “How did you feel about being body scanned?”

Closed-ended questions. Respondents were asked to respond on 5-point scales to the questions: “Has your experience of the scanner changed your attitude toward being scanned?” (much more negative, slightly more negative, no change, slightly more positive, much more positive); “Has your body satisfaction changed since being scanned?” (much less satisfied, slightly less satisfied, no change, slightly more satisfied, much more satisfied) and “How likely is it that you would have another body scan?” (very unlikely to very likely).

Body satisfaction measure. Body satisfaction was measured using a single-item 5-point scale to answer the question: “How do you feel about your body?” (very dissatisfied, slightly dissatisfied, neutral, slightly satisfied, very satisfied). Pilot work with a sample of 31 UK female undergraduate students showed a correlation of $r = .73$ ($p < .001$) between scores on our single-item scale and Cash’s (2000) Appearance Evaluation sub-scale of the Multidimensional Body-Self Relations Questionnaire.

Measures of weight and height. Women were weighed in kilograms on Marsden MPMS-250 weighing scales, and their height was measured in centimeters using a Leicester Height Measure at the time when they were body scanned. These measurements were used to calculate Body Mass Index (weight in kg divided by height in meters squared).

Procedure

Ethical approval for the study was obtained through Manchester Metropolitan University University ethics committee. Women who had been whole-body scanned during two clothes-technology studies were sent a link to an online questionnaire. All had been scanned using a TC2 KX-16 scanner (TC2, 2011) and had received printed copies of their scans. It was made clear

that participation was voluntary. Respondents' anonymity was assured using unique personal codes.

Data Analysis

Quantitative data were analyzed using one-sample chi-squared tests to compare the whole sample on experiences of the scanner (collapsed into positive, neutral, and negative categories); body satisfaction change since scanning (collapsed into more satisfied, neutral, and less satisfied categories); and likelihood of being scanned again (collapsed into likely, neutral, and unlikely categories). Multiple regression was then used to investigate whether current body satisfaction (scored 1 = very dissatisfied to 5 = very satisfied), age, scanner group (July/September), and body mass index predicted attitudes toward being scanned (scored 1 = much more negative to 5 = much more positive), likelihood of being rescanned in the future (scored 1 = very unlikely to 5 = very likely), and change in body satisfaction since being scanned (scored 1 = much less satisfied to 5 = much more satisfied). Scores on all key variables were also compared between groups scanned in July and September using t-tests.

Responses to the open-ended question were submitted to a thematic analysis broadly informed by the procedures of Grounded Theory (Strauss & Corbin, 1990). Line-by-line open coding was first used to identify initial categories, then axial coding was applied to the data and relational sampling and constant comparison were used to modify, confirm, and elaborate categories. Women were divided into those who indicated that they were currently “slightly satisfied” and “very satisfied” (satisfied group; n = 21), neutral (neutral group; n = 17), and “slightly dissatisfied” and “very dissatisfied” (dissatisfied group; n = 53) for the purposes of looking at qualitative responses in relation to current body satisfaction. All five authors debated

an initial model and agreement was reached on all themes. A total of six themes emerged; these are described below under the headings for the research questions to which they relate: information, comfort with the process, disbelief, shock, perceived vulnerability, and motivation to change behavior.

Results

How Do Women Feel About Being Whole-Body Scanned, and Are These Feelings Linked With Body Satisfaction, Age, and Body Mass Index at Time Of Scanning?

Closed-ended questions. Thirty-eight (42%) out of 91 women reported being more positive about being body scanned after being scanned, 41 (46%) reported no change, and only 12 (13%) were more negative; $\chi^2(2, N = 91) = 16.77, p < .0001$, showing that women were more likely to be either positive or neutral than negative about being scanned. There was a significant difference in mean attitudes toward scanning between the two groups, with women scanned in July being significantly more positive about scanning than those scanned in September (Table 2).

[Table 2 about here]

Multiple regression (Table 3) showed that attitude toward being scanned was not predicted significantly by BMI at time of scanning, age, or current body satisfaction score, but was predicted significantly by time of scanning, with those scanned at the July event being significantly more positive about the scanner experience ($\beta = -.29; t = -2.57; p < .01$). This possibly relates to logistical differences at the two events, or could be a result of women having a longer time lag to consider the experience of being scanned.

[Table 3 about here]

A comparison between the two groups on all key variables found a significant difference in their ages, with the July group being significantly younger on average ($t = -3.86; p < .05$) than the group scanned in September (Table 2). However, as age did not predict being positive about being scanned, it seems unlikely that the observed differences in attitudes were caused by this variation in age between groups. It seems more likely that having longer to reflect on the scanner experience made women more positive about scanning. Obviously the women who were scanned in July may have differed from those scanned in September in other respects that were not assessed here, and there may also have been subtle differences between the scanning process at the two events, so further research where the same women are asked to share their experiences at a variety of time points post-scanning will shed some more light on this interesting finding.

Sixty-two (68%) women reported that they would be likely to have another body scan, and 18 (20%) unlikely; $\chi^2(2, N = 89) = 54.23, p < .0001$. Likelihood of being rescanned was not predicted by age, BMI at time of scanning, current body satisfaction, or time of scanning (Table 2). The fact that BMI did not predict attitude toward being scanned or likelihood of being rescanned suggests that women of different sizes felt similarly about the scanner process, supporting suggestions from other authors such as Loker et al., (2004). It is also interesting that current body satisfaction did not predict attitude toward being scanned or likelihood of being rescanned, suggesting that women of different satisfaction levels were equally comfortable with the procedures employed in being scanned; this supports reports from Domina and colleagues (2008).

Open-ended question: Information. Thematic analysis of qualitative data showed that the most common response to being scanned was that the scan provided useful, objective information on how women's bodies looked from different angles, and that the scan and

associated measurements would help women choose clothes that would fit better. This suggests that women would be amenable to the use of body scanners to inform their selection and purchase of garments. A total of 29 out of 91 women presented an account based around the need for information about their bodies; seven of these women were satisfied with their bodies, seventeen were dissatisfied, and five were neutral. Women were keen to see an accurate and objective view of their size and shape. For instance, one body-satisfied woman said, “It was fascinating to see my body image and to find out the different measurements” (P65), and one dissatisfied woman reported that she was “intrigued and interested to see my shape at different angles” (P33). Women felt that the scanner provided them with information that they were not able to get through other means, such as looking in a mirror, as suggested by other authors (Domina et al., 2008; Loker et al., 2004). This enabled them to see more clearly exactly how their bodies looked from a 3D perspective, and this information was interesting and useful particularly in relation to finding clothes that fit well. For instance, one body-dissatisfied woman focusing on the information value of the scan and measurements provided reported, “I was delighted to receive the detailed information about my measurements which will help me make better informed decisions when choosing clothes” (P24).

Comfort with the process. Twenty-two women commented on how they felt about the procedure employed. Fourteen women spontaneously reported that they felt comfortable being scanned. For instance, one satisfied women said she was “relaxed and had no issues” (P59) and one dissatisfied woman reported she was “very comfortable being scanned despite being overweight” (P76). However, for those who were less comfortable with the process, privacy was a key issue, and three women (all body-dissatisfied) reported that they were concerned about lack of privacy. For instance, one of these women said the scan “felt quite invasive. It wasn’t

explained whether it was totally private or not i.e. could the cameraman actually see me?” (P37). When whole-body scans are used in the future it is crucial that women are fully informed about the fact that the technician is by default only able to see a surface representation of the body, rather than a photorealistic image, when looking at the scan image on the monitor, especially if the technician is male (which was a particular concern to some of our participants). Seeing examples of outputs from previous scans prior to scanning might allay these concerns and should be considered for introduction into whole-body scanning protocols.

Disbelief. A small number of women (four in total; three dissatisfied and one satisfied) did not believe in the validity of the images they were seeing. For instance, one dissatisfied woman reported, “My friends who saw the scan said that it looked on the ‘squashed’ side so made me look bigger than they perceived me but not sure if they were just trying to be kind” (P52), and one satisfied woman disputed the measurements shown on the scanned image: “The scan measured me with larger sizes than the tape measure does at home” (P89). It has been suggested previously (Grogan et al., 2013) that whole-body scanning might be a useful intervention to improve body image through showing women objective images of their bodies and hence reducing body overestimation. In order for this to be viable, it is crucial that women believe that the images are realistic. Further work is needed to find better ways of convincing women of the validity of the technique, possibly through providing more technical information on the process itself and how it compares to existing manual methods that participants may use for comparison.

Do Women Report Changes in Body Satisfaction Since the Scan?

Closed-ended questions. If impacts of scanning on body image are generally positive, then whole-body scanning could be used as part of interventions to improve women’s body satisfaction. These data might also inform product development and selection, and thus were of

particular interest. Of the women who responded to our online questionnaire, more than half were dissatisfied with their bodies, as might be expected based on previous work suggesting that body dissatisfaction tends to be normative in UK samples (Grogan, 2008). Unfortunately, when asked about body satisfaction since the scan, 31 women out of 91 (34%) reported that they had felt more negative about their bodies since the scan. Of the others, 54 (59%) reported no change, and only six (7%) said they felt more positive; $\chi^2(2, N = 90) = 36.87, p < .0001$ (one woman declined to comment). Multiple regression showed that neither BMI, age, nor time of scanning predicted perceived change in body satisfaction since the scan. However, women scoring higher in current body satisfaction reported a more positive change since the scan ($\beta = .39; t = 3.25; p = .002$). Although this result needs to be interpreted with caution given that we did not conduct pre-tests of body satisfaction at the time of scanning, it suggests that the scanner process may affect women who are satisfied with their bodies more positively than women who are less satisfied with their bodies, or that women may attribute their current body satisfaction to their experiences with the scanner. Further research including pre-tests could determine the validity and reliability of this finding.

Open-ended question: Shock. Qualitative analysis showed that five women, all of whom were high in body dissatisfaction, responded to their scans with shock. For instance, one woman said, “The 3D image was a shock” (P42), and another was “shocked by the results. It really showed how overweight I am” (P3). For this small group of women, the scan image did not match their image of how they thought that they looked, and they all expected to look slimmer than they did in the scan. Further work could investigate more definitively whether this kind of experience might result in greater objectification of the body as might be suggested by Objectification Theory (Fredrickson & Roberts, 1997); written accounts suggested increased

body objectification and focus on feelings of fatness after the scan for these women, one of whom stated, “The 3D image was a shock and the measurements. It has made me start a diet and fitness routine. I have quite slim arms and legs so I want to get the rest of my body in proportion” (P42).

Perceived vulnerability. Qualitative data showed that ten women (eight body-dissatisfied and two neutral) reported that they felt threatened and vulnerable about seeing their bodies on the printed output. For instance, one dissatisfied woman said, “I was very upset by the whole experience. It wasted about a quarter of the time I was at the show and made me feel anxious and unhappy. I was still unhappy about it days later” (P22), and one body-satisfied woman reported, “I don’t have any concerns about my body, and I’m not usually self-conscious, but this experience could have been unpleasant for someone lacking confidence in their body” (P63). These data support work by Loker and colleagues (2004), which suggests that some women are very concerned about seeing their bodies on the 3D scan. It is unclear why the present sample of UK women was more negative about seeing their scanned images than Grogan et al.’s (2013) UK sample. The sample of women in the present study varied in size and age more than Grogan et al.’s (2013) sample, which ranged only between 19.11-28.06 BMI and 18-45 years of age. However, neither BMI nor age predicted perceived body image change in the current study, making it unlikely that these were the key explanatory variables here. One obvious difference is that the participants in Grogan et al.’s (2013) study gave their accounts in interviews directly following the scan, rather than in an anonymous online questionnaire, and social desirability bias (the tendency to respond to questions in a socially acceptable direction; Spector, 2004), may have been more pertinent in face-to-face interviews. In the present study, the anonymity afforded

by the online format may have enabled participants to express more negative perceived impacts on body image.

Motivation to change behavior. In the case of three body-dissatisfied women, increased body dissatisfaction prompted by the scan resulted in motivation to reduce weight through increased exercise and healthy eating. For instance, one woman remarked that “the resulting scan was a real wake up call to me to do something about my weight and exercise” (P52), while another stated, “I looked less attractive than I thought I did, but on the plus side it has motivated me in my weight loss” (P83). One woman mentioned explicitly that the scan had “prompted me to eat healthily” (P29). Although these women had been disappointed by how they looked on the scan, it had motivated them to actively take steps to lose weight. These findings relate to the suggestion from one of Loker et al.’s (2004) participants that she should put the scan image on her fridge at home, presumably so that seeing the image would motivate her to reduce her food intake. So long as women do not engage in extreme weight loss diets, being motivated to eat more healthily and engage in higher levels of moderate physical activity could be seen as positive outcomes because of the well established positive impacts of physical activity and healthy eating on cardiovascular fitness (National Health Service, 2014). Further research needs to investigate this issue, asking direct questions about behavioral outcomes following the scan to determine more specific impacts on women’s behavior following being scanned, particularly in relation to eating and physical activity. Asking about body image in relation to perceived impacts on motivation to change behaviors will be informative in developing our understanding of links between scanning, body image, and motivation to exercise and eat more healthily.

Discussion and Conclusions

Summary of Results

Clearly further work is needed in this area, but at present whole-body scanning is not recommended as a way to promote more positive body image, although women tend to find the results informative and most are happy with the process itself. This seems especially pertinent when women have had longer to reflect on being scanned, though longitudinal assessment with the same group of women tested repeatedly over time will confirm or refute this. Although the results of this study suggest that whole-body scanning alone is unlikely to improve body image, it is possible that combining scanning with strategies to promote positive body image, such as the self-affirmation techniques and body appreciation exercises suggested by Tylka (2011), might enable us to capitalize on the perceived information value of the scans (see also Armitage, 2012). For instance, women could be supported in engaging in body-appreciation exercises while focusing on the aspects of the scans that they find most positive, and to reevaluate those parts that they dislike. This might be a way to provide women with a realistic view of how they look, while also promoting body satisfaction through focusing on the positives.

There is a need for further research to provide further contextual understanding and to enable participants in body scanning to be able to understand the process and outputs in a positive way. This could include further work on the factors that influence perceived comfort and privacy as part of the process. Interestingly, responses to being scanned were largely independent of BMI, although women's current body satisfaction linked to reported changes in satisfaction since the scan. Data presented here suggest that whole-body scanning, whether used to design clothes that fit well or for other reasons, should be used with caution, particularly with women with existing body concerns, and also suggest that BMI may not be a good predictor of who might find the scanner process more problematic.

Data lend some support to Objectification Theory (Fredrickson & Roberts, 1997), which suggests that contexts that prime self-monitoring for body faults can lead to feelings of body anxiety, particularly in those women who may be high in trait self-objectification. Although we found no evidence of increased body anxiety in body-satisfied women, seeing scanned images seemed to lead some women who were initially dissatisfied or neutral about their bodies to be critical of additional perceived flaws. Women high in body dissatisfaction, who might be expected to be highest in trait self-objectification (Grippio & Hill, 2008), were most likely to feel vulnerable and shocked by the images shown in the scans. Even women who were satisfied with their bodies reported increases in self-objectification as a result of scanning, although this was framed positively as giving them a more objective view of their body size and shape, which would enable them to buy clothes that fit.

Further research focused more explicitly around the key elements of Objectification Theory, and where trait and state self-objectification were measured directly, would enable a fuller understanding of the links between body scanning, self-surveillance, trait and state self-objectification, and appearance-related anxiety. However, the data presented here lend support to the idea that giving women an additional means to objectify their bodies through 3D body scans can lead to additional body-related self-criticism and feelings of vulnerability in the short- and long-term in women who are dissatisfied with their bodies. This finding has important health implications since self-objectification and body shame have been linked with negative health behaviors such as disordered eating (Tylka & Hill, 2004), smoking (Harrell, Frederickson, Pomerleau, & Nolen-Hoeksema, 2006), and intentions to have cosmetic surgery (Calogero, Pina, & Sutton, 2014).

Strengths and Limitations

Strengths of this study include the anonymity made possible through the online collection of data, the relatively large sample size, and the non-student population that enabled us to collect data from a heterogeneous sample of women. Also, the mixed methods approach used here meant that we were able to provide further interpretation of the quantitative responses using the qualitative data from the open-ended question. The qualitative data were informative in enabling us to understand in more depth some of the associations evidenced in the quantitative data, using the women's own words provided anonymously. The main limitation in this study was the relatively restricted qualitative data set compared to what might have been gained from in-depth interviews or focus groups. Focus groups or interviews may have provided richer and more detailed data and would have enabled us to follow up with responses that were unclear, though would possibly have constrained what women felt able to share.

Recommendations for Future Work

Further qualitative work should now be conducted to understand more fully the responses presented here. Longitudinal work will enable an assessment of reactions over a longer period in the same women. It may also be informative to audio-record what women say as they are being scanned and when they look at the scanned image, to provide additional data to compare with retrospective accounts. This has been found useful in studies investigating other appearance-related technology such as facial morphing (Grogan, Flett, Clark-Carter, Gough, Davey, Richardson, & Rajaratnam, 2010) and would enable capture of immediate responses to the images that could then be used to contextualize longer-term reactions. It would also be useful to investigate women's reactions to scans produced by other scanners. The TC2 scanner was originally selected because it was developed specifically to measure bodies for clothing purposes. This study focuses on the kinds of images that this scanner generates and therefore it is

possible that alternative scanners may provide images that women find more appealing. This is a potential area for further study.

It would also be valuable to measure body satisfaction directly before and directly after the initial scanner session to enable investigation of any changes in scores, and this could inform understanding of women's responses to any open-ended questions about impacts on body image. Future research could also determine whether body scanning could be used to promote positive body image in body-dissatisfied women. Also, looking directly at behavioral reactions to scanning will be useful, especially in relation to possible increases in healthy behaviors such as increases in moderate physical activity and healthy eating.

Conclusions

As whole-body scanning becomes more widely used to enable clothes manufacturers to determine optimal fit for clothes and researchers to understand links between body measurements and clothes choices, and people become more experienced at seeing body scans online and in settings such as airports, we need to be mindful of the impact of scanning on the people who agree to be scanned. Although care needs to be taken not to overgeneralize from this relatively modest data set, data presented here suggest that we should perhaps be cautious when scanning women, especially those whom we know to have body concerns. This is especially important as 3D views of the body showing more photorealistic images have become available through technologies such as virtual-fit and virtual-try-on (Loker, Ashdown, & Carnrite, 2008). Further research may enable us to find ways to use whole-body scans positively to promote health and well-being.

References

- Aghekyan, M., Ulrich, P., & Connell, L. (2012). Using body scans in assessing perceptions of body attractiveness and size: Cross-cultural study. *International Journal of Fashion Design, Technology and Education*, 5(2), 81-89.
- Armitage, C. J. (2012). Evidence that self-affirmation reduces body dissatisfaction by basing self-esteem on domains other than body weight and shape. *Journal of Child Psychology and Psychiatry*, 53(1), 81-88.
- Bougourd, J. P., Dekker, L., Grant Ross, P. & Ward, J. P. (2000). A comparison of women's sizing by 3D electronic scanning and traditional anthropometry. *Journal of Textiles Institute*, 91(2), 163-173.
- British Heart Foundation (2015). *Your BMI*. Retrieved from <http://extras.bhf.org.uk/bmi/overweight.html>
- Calogero, R. M., Pina, A., & Sutton, R. M. (2014). Cutting words: Priming self-objectification increases women's intentions to pursue cosmetic surgery. *Psychology of Women Quarterly*, 38(2), 197-207.
- Cash, T. (2000). Users' Manual for the Multidimensional Body-Self Relations Questionnaire. Available from the author on <http://www.body-images.com>
- Cornelissen, P. L., Johns, A., & Tovee, M. J. (2013). Body size over-estimation in women with anorexia nervosa is not qualitatively different from female controls. *Body Image*, 10(1), 103-111.
- Domina, T., Heuberger, R., & MacGillivray, M. (2008). Examination of body image issues and willingness to be scanned. *Women and Health*, 46(4), 99-116.

- Fredrickson, B. L., & Roberts, T. A. (1997). Objectification theory: Toward understanding women's lived experiences and mental health risks. *Psychology of Women Quarterly*, 21(2), 173-206.
- Frith, H. (2012). Appearance and society. In N. Rumsey & D. Harcourt (Eds.), *The Oxford handbook of the psychology of appearance* (pp. 10-23). Oxford, United Kingdom: Oxford University Press.
- Grippo, K. P & Hill, M. S. (2008). Self-objectification, habitual body monitoring, and body dissatisfaction in older European American women: Exploring age and feminism as moderators. *Body Image*, 5(2), 173–182.
- Grogan, S. (2008). *Body image: Understanding body dissatisfaction in men, women and children* (2nd edition). London, United Kingdom: Routledge.
- Grogan, S., Flett, K., Clark-Carter, D., Gough, B, Davey, R., Richardson, D., & Rajaratnam, G. (2010). Women smokers' experiences of an age-appearance anti-smoking intervention: A qualitative study. *British Journal of Health Psychology*, 16(4), 675-689.
- Grogan, S., Gill, S., Brownbridge, K., Kilgariff, S., & Whalley, A. (2013). Dress fit and body image: A thematic analysis of women's accounts during and after trying on dresses. *Body Image*, 10(3), 380-388.
- Harrell, Z. A., Frederickson, B. L., Pomerleau, C. S., & Nolen-Hoeksema, S. (2006). The role of trait self-objectification in smoking among college women. *Sex Roles*, 54(11-12), 735-743.
- National Health Service (2014). Start losing weight. *NHS Choices*. Retrieved from <http://www.nhs.uk/Livewell/loseweight/Pages/start-losing-weight.aspx>
- Istook, C. L. (2000). Rapid prototyping in the textile and apparel industry: A pilot project. *Journal of Textile and Apparel Technology and Management*, 1(1), 1-14.

- Loker, S., Ashdown, S., & Carnrite, E. (2008). Dress in the third dimension: Online interactivity and its new horizons. *Clothing and Textiles Research Journal*, 26(2), 164-176.
- Loker, S., Cowie, L., Ashdown, S., & Lewis, V. D. (2004). Female consumers' reactions to body scanning. *Clothes and Textile Research Journal*, 22(4), 151-160.
- Spector, P. (2004). Social desirability bias. In M. Lewis-Beck, A. Bryman, & T. Liao (Eds.), *Encyclopedia of social science research methods* (pp. 1045-1046). Thousand Oaks, CA: Sage.
- Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. London, United Kingdom: Sage.
- TC2 (2011). *KX-16 3D Body Scanner: For apparel, health/fitness/medical, entertainment/gaming, and virtual worlds*. Cary, NC: TC2.
- Tiggemann, M., & Andrew, R. (2012). Clothing choices, weight, and trait self-objectification. *Body Image*, 9(3), 409-412.
- Tiggemann, M., & McCourt, A. (2013). Body appreciation in adult women: Relationships with age and body satisfaction. *Body Image*, 10(4), 624-627.
- Tylka, T. L. (2011). Positive psychology perspectives on body image. In T. F. Cash & L. Smolak (Eds.), *Body image: A handbook of science, practice, and prevention* (pp. 56-64). New York, NY: Guilford.
- Tylka, T. L., & Hill, M. S. (2004). Objectification theory as it relates to disordered eating among college women. *Sex Roles*, 51(11-12), 719-720.

Table 1.

Demographic Data for Study Sample Compared to Parent Sample

	Parent Population				Study Sample			
	N	Mean	Min.	Max.	N	Mean	Min.	Max.
Body Mass Index (BMI)	456	27	16	56	91	25	19	42
Age (years)	456	46	18	84	91	51	18	81
Self-reported Ethnicity								
White	372				80			
Mixed white/Asian	5				1			
Mixed white/black	7							
Black	19				2			
Asian	13							
Chinese	4				1			
Other mixed background	3							
Other ethnic group	3							
No response to item	30				7			

Table 2.

Comparison Between Samples from July and September Fashion Events on Key Variables

	July Scan Sample (n = 46)		September Scan Sample (n = 45)		<i>t</i>	<i>p</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>		
Body Mass Index (BMI)	26.5	6.24	26.77	6.24	-0.18	.978
Age (years)	41.8	15.7	54.3	14.2	-3.86	.051
Body Satisfaction	2.57	1.07	2.51	1.25	0.22	.219
Attitude to Scanning	3.70	.940	3.09	1.04	2.92	.494
Re-scan Likelihood	4.04	1.32	3.60	1.56	1.47	.067
Body Satisfaction Change	2.76	.773	2.51	1.25	1.80	.062

Table 3.

Regressions of BMI, Age, Time of Scanning and Body Satisfaction onto Scanner-related Variables

Predictors	Attitude to Scanning			Re-scan Likelihood			Body Satisfaction Change		
	B	SE	β	B	SE	β	B	SE	β
Body Mass Index (BMI)	.018	.019	.116	.019	.028	.086	.015	.016	.111
Age	-.004	.007	-.065	-.016	.011	-.182	.004	.006	.085
Time of Scanning	-.575	.224	-.296**	-.276	.334	-.098	-.328	.190	-.197
Body Satisfaction	.009	.100	.011	.124	.150	.102	.273	.084	.378**

** $p < .01$. Note. B = unstandardized coefficient; β = standardized coefficient. (N of participants = 91).

Figure 1. Scan Front View Taken From a TC2 scanner.

