Prosthesis use is associated with reduced physical self-disgust in limb amputees

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Abstract

Self-disgust is an emotion schema negatively affecting people's body image and is triggered by bodily imperfections and deviations from the "normal" body envelope. In this study, we explore the idea that "normalising" the body in those with limb amputations via the prosthesis would be linked to reduced self-directed disgust. An international clinical community sample (N = 83) with mostly lower limb amputations completed measures about their demographics, prosthesis, adjustment, body image disturbance, psychological distress, and self-directed disgust in a survey design. Consistent with the "normalising" hypothesis, correlation and bootstrapped regression models revealed, first, that frequency of prosthesis use was significantly and negatively associated with physical self-disgust. Second, prosthesis use significantly mediated the exogenous effect of time since amputation on physical self-disgust. These results emphasise the psychological value of the prosthesis beyond its functional use, and stress its importance in normalising the body envelope in those with limb amputations, which may in turn promote psychological well-being.

Keywords: self-disgust; adjustment; amputation; body image; prosthesis

Introduction

Disgust is a universal emotion (Ekman, 1992), theorised to have its evolutionary origins in the distaste response, which prevents an organism from ingesting noxious substances (Rozin & Fallon, 1987). The emotion functions to help people avoid disease by promoting the behavioural avoidance and rejection of unpalatable stimuli (Curtis, Aunger, & Rabie, 2004). Beyond oral disease threats, the human disgust-eliciting repertoire has expanded to include wider pathogenic stimuli, indicators of poor reproductive quality, reminders of death and mortality, and sociomoral transgressions that violate the moral virtues of divinity and purity (Chapman & Anderson, 2012). Disgust, then, serves to protect the border of our body (and mind) from a diverse range of (socioculturally-defined) potential external contaminants (Rozin, Haidt, & McCauley, 1999). It has been suggested that such contaminants include less attractive or atypical bodily features that mimic signs of infectious disease (e.g., acne; Oaten, Stevenson, & Case, 2011), trigger concerns about genetic and reproductive quality (e.g., obesity; Park, Schaller, & Crandall, 2007), and/or involve violations of an idealised and desirable exterior body shape (e.g., disfigurement; Shanmugarajah, Gaind, Clarke, & Butler, 2012).

As an emotion that is felt when the body border is violated, disgust is intimately linked to body image (i.e., the way an individual perceives and evaluates their own body). It has been associated with body stigma, criticism, and dissatisfaction (Griffiths & Page, 2008; Park et al., 2007) and linked to socioculturally-regulated bodily practices (e.g., menstruation; Fahs, 2014; Roberts, Goldenberg, Power, & Pyszczynski, 2002). Elevated disgust has been shown to negatively predict psychological well-being in physical and mental health conditions that involve changes to the body, such as cancer (Azlan, Overton, Simpson, & Powell, 2017; Powell, Azlan, Overton, & Simpson, 2016) and eating disorders (Troop & Baker, 2009). Physical atypicality is also a significant predictor of disgust reactions. For

example, people with higher levels of proneness to disgust tend to report greater negative reactions and visual attention to photos of disfigured faces (Shanmugarajah et al., 2012; Stone & Potton, 2018). In the present study, we consider the role of disgust in the context of another salient source of bodily change: that induced by limb amputation.

Limb amputations are a prototypical case where one would expect disgust to feature. They involve violations of an idealised body envelope (i.e., the exterior body border), they are associated with reminders of mortality and death, and are linked to pathogen or disease concerns. Indeed, limb amputation stimuli have been used to induce disgust states in people experimentally (e.g., Rohrmann, Hopp, Schienle, & Hodapp, 2009). Yet, despite this, no work has considered the role of disgust responses in individuals with limb amputations. In the context of amputation, one particular form of disgust – self-disgust – may be particularly pertinent. While disgust elicitors are often contextualised as external to the agent, the self (and its attributes) can function as its own disgust object (Overton, Markland, Taggart, Bagshaw, & Simpson, 2008; Powell, Simpson, & Overton, 2015a; Power & Dalgleish, 2008).

Self-disgust has been theorised as an "emotion schema" involving a persistent disgust-based cognitive-affective orientation toward (bodily and/or characterological features of) the self (Powell, Simpson, et al., 2015a). It has been conceptualised as part of the emotional pantheon centred on bodily characteristics (Fox, 2009; Moncrieff-Boyd, Byrne, & Nunn, 2014; Neziroglu, Hickey, & McKay, 2010), and considerable theoretical interest has been directed towards self-disgust as a pan-diagnostic concept relevant to the development and maintenance of poor psychological health (Powell, Simpson, et al., 2015a). For example, Powell, Simpson, and Overton (2013) identified physical self-disgust to be particularly important in the longitudinal prediction of depression.

Following limb amputation, self-disgust may result from both the innate nature of amputation as a violation of the body envelope and through deviation from the body type that

society promotes as "normal" and desirable. In addition to psychosocial difficulties (e.g., adjustment, body image disturbance, and mental health difficulties), self-disgust may promote the use of different maladaptive coping mechanisms. Qualitative research has found that individuals experiencing self-disgust distance themselves from the aspect of self they find disgusting, engaging in behaviours that avoid the disgusting self (Powell, Overton, & Simpson, 2014). For example, people with eating disorders often avoid situations of bodily awareness that trigger self-disgust (Espeset, Gulliksen, Nordbø, Skårderud, & Holte, 2012). Unregulated disgust reactions in the context of healthcare have been shown to lead to behaviours that are deleterious to recovery, such as the avoidance of wound care (Gaind, Clarke, & Butler, 2011). Accordingly, self-disgust in those with amputations may give rise to avoidance of the residual limb, which could cause further physical health problems. Self-disgust may also contribute to the high levels of depression and anxiety that are common following limb amputation (Desmond, 2007; Mckechnie & John, 2014).

Two primary sources of self-disgust have been identified in the literature, those based on "physical" aspects of the self, such as the body and visual appearance, and those based on "behavioural" aspects of the self, including characterological aspects and the way people behave (Overton et al., 2008). While both types of self-disgust have been linked to mental health outcomes, some work has suggested they may have a differential importance in different areas, such as depression (Powell et al., 2013). In those with amputations, as the primary change to the self is physical, and not one's character or standard of behaviour, we may expect any observed effects to be stronger for physical than behavioural self-disgust.

One important factor that is likely to interact with body image and self-disgust in individuals with amputations is the use of prostheses. Beyond their functional benefit, prostheses provide a mechanism of "normalising" the body, both in terms of correcting the original physical body border and retaining a more prototypical physical appearance (Murray

& Forshaw, 2013). Accordingly, prosthesis use provides a method of reducing the disgust cues associated with the amputated limb. The use of the prosthesis post-amputation is associated with lower levels of unemployment (Whyte & Carroll, 2002), greater self-esteem (Durmus et al., 2015), greater quality of life, and better adaption to limb loss (Akarsu, Tekin, Safaz, Goktepe, & Yazicioglu, 2013; Zidarov, Swaine, & Gauthier-Gagnon, 2009). Furthermore, Durmus and colleagues (2015) found that the length of prosthesis use, daily hours of prosthesis use, and satisfaction with the prosthesis were negatively correlated with "general psychiatric symptomatology" (including depression and anxiety). Given the focus on the physical "self," and link with mental health and well-being, these positive effects of prosthesis use may be engendered, at least in part, via an impact of prosthesis use on self-directed disgust. Equally, we may expect lower levels of self-disgust to reduce avoidance of the amputated limb, and thereby increase the likelihood the prosthesis would be used. Research has documented that prosthesis use typically increases over time and is more frequent in individuals with older than newer amputations (e.g., Pezzin, Dillingham, MacKenzie, Ephraim, & Rossbach, 2004), and psychological adaptation to the amputation also improves (Horgan & MacLachlan, 2004). Consequently, we may expect the benefit from "normalising" the body via an increasing use of the prosthesis to become more evident over time, and mediate the effect of time elapsed since amputation on self-disgust.

There is, thus, a strong theoretical case for considering self-disgust and prosthesis use to be linked. As a consequence, it is important to determine empirically how self-disgust relates to prosthesis use, and prosthesis satisfaction, in order that appropriate interventions can be developed to facilitate the betterment of psychological well-being and psychological adaptation in those with amputations. Accordingly, the aim of the present study was to explore the relationship between prosthesis use, prosthesis satisfaction, and body image disturbance, as well as demographic, clinical, and psychosocial factors, in predicting physical

and behavioural self-directed disgust following limb loss. We expected that prosthesis use would be negatively associated with self-disgust in the face of other important predictor variables, with stronger effects for physical than behavioural self-disgust. Based on the fact that prosthesis use and psychological adaptation to the amputation improves over time (Horgan & MacLachlan, 2004; Pezzin et al., 2004), we also explored whether prosthesis use had a significant mediating (explanatory) effect on the exogenous (unidirectional) relationship between time since amputation and levels of self-disgust.

Method

Participants

Eighty-three participants (37 women) with (majority lower, *n* = 78) limb amputations took part in this study. The age of the participants ranged from 18 to 78 years (*M* = 52.44, *SD* = 14.10). The majority of participants identified as White/Caucasian (*n* = 79), and were recruited from predominantly English-speaking countries: United States (*n* = 57), United Kingdom (*n* = 12), Australia (*n* = 10), Canada (*n* = 2), Switzerland (*n* = 1), and South Africa (*n* = 1). Time since amputation ranged from 0 to 48 years (*M* = 12.66, *SD* = 14.13). Reasons for amputation included "other" (*n* = 34; e.g., "infection"), "accident" (*n* = 28), "diabetes" (*n* = 14), "vascular disease" (*n* = 10), and "cancer" (*n* = 7); 68% (*n* = 56) of the sample reported experiencing residual limb pain, while 75% (*n* = 62) reported experiencing phantom limb pain. Prosthesis use ranged from 0 to 558 hours of an average month (*M* = 379.28, *SD* = 161.54). Of the participants, 66% (*n* = 55) reported below-knee, 27% (*n* = 22) above-knee, 2% (*n* = 2) above-elbow, 1% (*n* = 1) through-knee, 1% (*n* = 1) below-elbow, and 2% (*n* = 2) "other" types of amputation.

Measures

Demographics and clinical information. Demographics included participants' age, sex, country of residence, and ethnicity. Clinical variables included the time since

amputation in years and months (merged into a single continuous index of years with monthly intervals), the level and cause of amputation (accident: 1 = *yes*, 0 = *no*), whether they experienced residual and phantom limb pain (1 = *yes*, 0 = *no*), and, on average, how many days per month and hours per day they wore a prosthesis (converted to an index of hours per month).

Self-disgust. Self-disgust towards physical and behavioural attributes of the self was measured using the Self-Disgust Scale-Revised (SDS-R; Powell, Overton, & Simpson, 2015). It is a 22-item measure, with 7 filler items, and a 7-point Likert-type scale (1 = *strongly disagree*, 7 = *strongly agree*). Based on earlier psychometric evaluation (Powell, Overton, et al., 2015), the SDS-R has two separable 5-item subscales that load onto physical and behavioural aspects of self-disgust. These two subscales (physical and behavioural self-disgust) were used in this study. The remaining 5 items that have been shown to cross-load across these factors were omitted from analyses. Scores in each subscale can range from 5 to 35, with higher scores indicating greater self-disgust. Scores on the SDS-R have previously been shown to have adequate internal reliability ($\alpha = .92$) and convergent validity, demonstrating a moderate correlation with the sensitivity subscale of the Disgust Propensity and Sensitivity Scale-Revised (DPSS-R; van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006), $r_s = .41$, $p < .001$ (Powell, Overton, et al., 2015). The internal consistency estimates of the physical ($\alpha = .88$) and behavioural ($\alpha = .90$) subscales in the current sample were adequate.

Psychosocial adjustment. Psychosocial adjustment was measured using the TAPES-R Psychosocial, part of the Trinity Amputation and Prosthesis Experience Scales – Revised (TAPES-R; Gallagher, Franchignoni, Giordano, & MacLachlan, 2010). It is a 15-item scale measuring general adjustment, social adjustment, and adjustment to limitations (subscale reversed). The measure uses a 4-point Likert-type scale (1 = *strongly disagree*, 4 = *strongly*

agree), but participants may also choose "not applicable." Total scores are calculated by reversing the item scores within the adjustment to limitations subscale and averaging applicable responses. Possible scores range from 1 to 4, with higher scores indicating better adjustment. Scores on the Psychosocial scale of the TAPES-R have previously shown adequate internal reliability (α = .89; Gallagher et al., 2010). The measure displayed an adequate internal consistency estimate in this sample (α = .90).

Satisfaction with prosthesis. Participants' aesthetic and functional satisfaction with their prosthesis was measured using the TAPES-R Satisfaction. It is an 8-item measure, scored on a 3-point Likert-type scale (1 = *not satisfied*, 3 = *very satisfied*). Scores range from 8 to 24, with a higher score indicating greater levels of satisfaction. Scores on the Satisfaction scale of the TAPES-R have previously shown adequate internal reliability (α = .95; Gallagher et al., 2010). The internal consistency estimate of the measure in this study was adequate (α = .92).

Body image disturbance. Body image disturbance was measured using the Amputee Body Image Scale-Revised (ABIS-R; Gallagher, Horgan, Franchignoni, Giordano, & MacLachlan, 2007). It is a 14-item measure, scored on a 3-point Likert-type scale (0 = *none of the time*, 2 = *most/all of the time*). Total scores are derived from reverse coding two items and them summating, and range from 0 to 28. Scores on the scale are one-dimensional and have adequate internal reliability (α = .87; Gallagher et al., 2007). In this study, one item that refers to an experience specific to lower limb amputation (i.e., limping) was removed prior to data collection to make the scale consistent for those without lower limb amputation. Thus, an amended 13-item version of the ABIS-R was used in this study, with scores ranging from 0 to 26 and yielding adequate internal consistency (α = .92).

Psychological distress. Participants' psychological distress was measured using the short form of Lovibond and Lovibond's (1993) Depression, Anxiety, and Stress Scales

(DASS-21). This is a 21-item scale and participants rate how much each statement applied to them over the past week. It is scored on a 4-point Likert-type scale (0 = *did not apply to me at all*, 3 = *applied to me very much, or most of the time*). Summed scores are then multiplied by two to make them comparable with the original DASS. Scores range from 0 to 126, with higher scores indicating greater distress. Previous psychometric work has established the construct validity of the DASS in measuring an overall construct of "psychological distress" (Henry & Crawford, 2005). Scores on the scale have also been shown to be internally reliable ($\alpha = .93$; Henry & Crawford, 2005). The internal consistency estimate in this sample was adequate ($\alpha = .95$).

Procedures

Ethics approval was provided by Lancaster University Faculty of Health and Medicine Research Ethics Committee and the University Research Ethics Committee. Informed consent was acquired prior to data collection. Data were not included in the study if the consent procedure was not completed or if the study was exited before the end. Survey data were collected online (via Qualtrics) and through hardcopy from an amputation support group. An opportunity sample of individuals with amputations was recruited internationally via advertisements on social media (e.g., Twitter), amputation and prosthesis-related organisational websites and related media (e.g., LimbLine magazine), amputation discussion forums, and an amputation ListServ group. Additionally, an amputation support group in Liverpool, United Kingdom, was contacted and provided with hardcopies that could be returned via freepost. Recruitment took place over a 6-month period between October 2015 and March 2016. The online and hardcopy versions of the survey were identical, except in minor instructions to the participants of how to indicate their responses (i.e., mark versus click).

The online version of the survey was accessed 150 times and, of these, 110 individuals proceeded from the participant information sheet to the consent procedure, of whom 95 provided consent. Of these 95 people, 13 exited (withdrew) before the end of the survey, leaving a total of 82 online participants. Two hard copies of the study were returned from the Liverpool amputation support group, of which only one had completed the consent procedure; the other data were destroyed, resulting in one participant whose data came from hardcopy.

The inclusion criteria for participation was having experienced limb loss, having access to the use of a prosthesis, and being 16 years of age or above. Participants were unable to take part if they were restricted in the use of a prosthesis for any reason other than personal choice (e.g., medical recommendation) or used a prosthesis to aid with congenital limb difference (i.e., not as a result of amputation). Participants were informed that the study was "exploring the relationship between thoughts or feelings about amputation and the extent to which adults who have an amputated limb use a prosthesis or artificial limb." Participants completed the survey in the following fixed order: participant information, informed consent, demographics and clinical information, TAPES-R Psychosocial, TAPES-R Satisfaction, questions on residual and phantom limb pain, SDS-R, ABIS-R, and the DASS-21. Following this, on the final page of the survey, participants were thanked for their time and directed to support resources in the event of distress. Participation was completely anonymous and participants did not receive any remuneration for their time.

Data Analysis

Missing data. There was a relatively minor amount of missing data, 41 instances across four variables and eight participants. No patterns emerged from a Missing Value Pattern analysis, and Little's test for missing completely at random (MCAR) was non-significant, $\chi^2(312) = 328.65$, $p = .248$, suggesting that estimates based on listwise deletion

would not be systematically biased, but they would nevertheless be inefficient (Dong & Peng, 2013). Accordingly, established procedures for dealing with missing data were followed (Graham, 2009). One participant who accounted for 83% (34 instances) of the missing data was omitted from further analyses. The remaining seven instances of missing data were imputed using an expectation-maximisation (EM) algorithm (Graham, 2009). All inferential analyses were performed using an imputed "complete" dataset for 82 participants. All descriptive data are reported prior to imputation. Note that the findings reported below are qualitatively identical using a reduced "complete case analysis" (n = 75), or if the analysis is restricted to those only with lower limb amputations (n = 77).

Predictive analysis. As some of the variables and model residuals exhibited non-normality, we used Spearman's rho correlation estimates and bias-corrected and accelerated bootstrapping (BCa) to generate more robust confidence intervals and probability values for regression model estimates. Bootstrapping is a robust alternative to traditional parametric estimates, when those estimates may be biased (e.g., due to violations of parametric assumptions; Fox, 2008). Ten thousand resamples were used for the bootstrapped estimates (Mallinckrodt, Abraham, Wei, & Russell, 2006).

Correlations were performed between demographic, clinical, and psychosocial variables, in order to assess which variables had a statistically meaningful relationship with physical and behavioural self-disgust. We then regressed physical and behavioural self-disgust on frequency of prosthesis use with and without the covariates that had been identified as having a significant bivariate relationship with levels of self-disgust in the correlation matrix. Finally, we estimated a mediation model with prosthesis use as a mediator between the exogenous (unidirectional) variable of time since amputation and the outcomes of physical and behavioural self-disgust, with and without exogenous and endogenous covariates (see Figure 1). Given the amount of data available, as a ratio to the

sample size, to avoid multicollinearity and overfitting of the models, total scale scores of predictor values were used wherever possible. Descriptive, correlational, and regression analyses were conducted via SPSS v 22 (IBM Corp., Armonk, NY, USA) and the mediational path analyses were estimated on AMOS v 24 (IBM Corp., Armonk, NY, USA).

A sensitivity power analysis on G*Power 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that, with a sample of 82 people and an alpha of .05, an effect size of f^2 = .098 or larger for a single predictor added to a regression model would be required for the study to have 80% power. This is recognised as a small to medium effect (Cohen, 1988).

Results

Descriptive Statistics and Bivariate Associations

A summary of the descriptive data for the self-report questionnaire scales is presented in Table 1. On average, this sample demonstrated a good level of adjustment to amputation, was satisfied with their prosthesis, had relatively low physical and behavioural self-disgust, body image disturbance, and psychological distress scores. However, the range of values across these scales was considerable, with some participants indicating greater psychological well-being than others (see Table 1).

Bivariate correlations between the key study variables are presented in Table 2. Frequency of prosthesis use had a medium-sized significant negative correlation with physical self-disgust and a small significant negative correlation with behavioural self-disgust, while time since amputation had a small significant negative correlation with physical self-disgust only. Age, psychosocial adjustment, and satisfaction with the prosthesis were all also significantly negatively correlated with physical and behavioural self-disgust, with coefficients ranging from small to large. Residual limb pain had a small significant positive correlation with physical self-disgust. Body image disturbance and psychological

distress were strongly positively associated with physical and behavioural self-disgust, with large correlation coefficients.

Path Models

The results of the regression models are presented in Table 3. Both before and after controlling for covariates that demonstrated a significant bivariate relationship with self-disgust, frequency of prosthesis use had a significant relationship with physical self-disgust (the second largest estimated coefficient after body image disturbance). Prosthesis use did not significantly relate to behavioural self-disgust before or after controlling for covariates.

Key estimates from the mediation model (see Figure 1) are presented in Table 4. In this model all exogenous predictors and covariates (time since amputation and age) were included on the left hand side of the model, with endogenous mediators in the middle, and physical and behavioural self-disgust as outcomes. In the uncovaried model, all parameters associated with the covariates were constrained to zero. Both in the uncovaried and covaried mediation model, time since amputation had a significant effect on physical self-disgust via frequency of prosthesis use. These indirect effects did not reach significance for behavioural self-disgust.

Discussion

The aim in this study was to explore the relationships between prosthesis use, prosthesis satisfaction, and body image, as well as demographic, clinical, and psychosocial factors, in predicting physical and behavioural self-directed disgust following limb loss. In accordance with the first hypothesis, frequency of prosthesis use was significantly associated with levels of physical (but not behavioural) self-disgust in this sample, both before and after controlling for covariates. This is consistent with initial expectations that limb loss primarily affects perceptions of the physical (vs. behavioural) self, which may be attenuated by use of the prosthesis. Furthermore, in relation to the mediation model, time since amputation (an

exogenous predictor) had a significant indirect effect on physical self-disgust via its effect on frequency of prosthesis use. Put simply, the longer the time since amputation, the greater the frequency of prosthesis use (or "normalising"), and the lower the level of physical self-disgust. Together, these findings highlight the importance of prosthesis use beyond its functional benefit, by its association with reduced physical self-directed disgust, and highlight the importance of the distinction between physical and behavioural self-disgust as outcomes. The findings support our "normalising" theory of the prosthesis and are the first demonstration of the relevance of prosthesis use among those with amputations in relation to feelings of physical self-disgust, which have been shown to a temporal predictor of mental health problems, such as depression (Powell et al., 2013).

Not only was frequency of prosthesis use negatively correlated with physical self-disgust, but this relationship was maintained in the presence of age, time since amputation, psychosocial adjustment, satisfaction with the prosthesis, residual limb pain, body image disturbance, and psychological distress. Wearing a prosthesis helps to maintain the amputated limb in the body schema, an inclusion which is lost over time if a prosthesis is not worn (Mayer, Kudar, Bretz, & Tihanyi, 2008). As a consequence, wearing a prosthesis, by sustaining an intact image of a whole-body envelope, may help to offset the development and presence of self-disgust. Disgust is an emotion that helps to delineate the body border from external threats and contaminants (Rozin et al., 1999) and thus may be otherwise triggered when the body deviates from its long-established whole. Violations of the exterior body envelope are a well-established elicitor of disgust (Rozin et al., 1999), and we propose that wearing a prosthesis helps to nullify this disgust elicitor in the self and others. Of course, rather than prosthesis use solely affecting self-disgust, it is also possible that a reduction in self-disgust may result in a greater use of the prosthesis, particularly as disgust is an emotion that promotes avoidance (Curtis et al., 2004). In truth, the simple bivariate relationship

between prosthesis use and self-disgust is likely to be bi-directional, at least to some extent. The effect of time since amputation on these variables, as featured in our mediation model, however, is not.

In addition to prosthesis use and time since amputation, levels of self-disgust were also found to correlate negatively with age, psychosocial adjustment, and satisfaction with the prosthesis, and positively with residual limb pain, body image disturbance, and psychological distress. Age has been reported previously to have a small negative correlation with self-disgust (e.g., Powell et al., 2013), and the association between higher levels of self-disgust and poorer psychological adjustment is not surprising given self-directed disgust's demonstrated role as a vulnerability factor for the development of depressive symptoms (Overton et al., 2008; Powell et al., 2013). While potentially bi-directional, the fact that prosthesis satisfaction was negatively associated with self-disgust is consistent with the "normalising" hypothesis and reinforces the importance of the prosthesis in self-directed affective evaluations of the self in individuals with amputations. Regarding post-amputation pain, higher levels of residual limb pain are likely to raise the patient's awareness of the amputated limb and the associated stump (see also Ribbers, Mudler, & Rijken, 1989), and therefore may be understandably related to higher levels of self-disgust.

Beyond self-disgust, positive relationships emerged between frequency of prosthesis use, as well as time since amputation, and psychosocial adjustment. In addition, there was also, perhaps unsurprisingly (see Durmus et al., 2015), a positive relationship between frequency of prosthesis use and satisfaction with the prosthesis. Successful adjustment to amputation has been associated with the use of prostheses in earlier work (Murray, 2004). Interestingly, neither frequency of prosthesis use nor time since amputation were significantly associated with body image disturbance in this sample, yet the latter was correlated with self-directed disgust. This link is probably unsurprising given that self-disgust is considered to be

a lasting disgust-based cognitive-affective orientation to some enduring and important feature of the self (Powell, Simpson, et al., 2015a). Prosthesis use and time since amputation also had weaker associations with psychological distress than they did with self-disgust. Prior work has linked increased prosthesis use to better quality of life (Zidarov et al., 2009) and lower levels of depression (Holmes & Spence, 2006; Nicholas et al., 1993). While these findings are of interest, this study is the first to show the importance of prosthesis use in managing physical self-disgust; a relationship that was still statistically evident when these other variables were accounted for.

Prosthesis training and ambulation are considered key aspects of recovery after limb loss, also facilitating social reintegration (Esquenazi & DiGiacomo, 2001). At present, the recovery process primarily focusses on the pragmatic, functional benefits of using an artificial limb. This is particularly the case for lower-limb loss (that comprises the vast majority of the limb loss population), where the aim is to make the individual with an amputation ambulatory. The findings from this study suggest that the prosthesis may serve another function in improving affective orientation to the body, through its association with reduced physical self-disgust. Emphasising the potential psychological benefits of the prosthesis in this regard is likely to be beneficial when dealing with psychological adaptation. Indeed, individuals with amputations who are exhibiting higher levels of self-disgust may be helped by being encouraged to use their prosthesis more as a tool to improve their psychological well-being, particularly if their level of prosthesis use is low. Conversely, to the extent that elevated self-disgust acts as a reciprocal barrier to greater prosthesis use, those with amputations who experience physical self-disgust may benefit from psychosocial interventions targeting self-disgust appraisals. A recent study by Powell, Simpson, and Overton (2015b) found that, when compared against a control group, self-affirming kindness led to a significant reduction in appearance-directed disgust. Self-affirmation may have

clinical utility as an intervention to reduce distress in individuals with limb loss who demonstrate elevated physical self-disgust.

Limitations and Conclusion

A number of limitations should be acknowledged. First, the study had an almost exclusive focus on individuals with lower limb amputations and, while they constitute the vast majority of limb amputations, it cannot be assumed that the findings of this study are necessarily valid for patients with upper limb amputations, for example. Indeed, the relationship of self-disgust and prosthesis use may be different for upper limb amputations due to increased visibility of the residual limb. It would therefore be of benefit to explore the relationship between prosthesis use and self-disgust in people with different kinds of amputations, including the upper limb.

Second, we used an opportunity, self-selected community sample of people with limb amputations. While this strategy has its advantages (e.g., not restricting the sample to those using particular clinical services), amputation status was not verified clinically, and there is a lack of data on participants' clinical experiences, such as engagement in rehabilitation programmes, which may act as critical moderators to the results observed. In addition, there was a degree of heterogeneity in both the sample and recruitment methods (e.g., involving people from multiple countries, and online and hardcopy response formats) that may have exerted unknown effects on the relationships observed. While the sample size was not large enough to conduct subgroup analyses, future work with larger homogeneous samples may be able to explore systematic group differences.

Third, the use of a fixed order in responses to the questionnaires may have induced order effects in participants' responses, which may have influenced the findings. The removal of one of the items from the ABIS-R (to make it more applicable to those with upper limb amputations) may have compromised its interpretative unidimensional structure in this

sample (relative to the full 14-item measure), yet the measure remained internally consistent. Finally, all data were collected using a cross-sectional design and thus any proposed directional relationships would benefit from validation using longitudinal datasets. As noted above, the relationship between prosthesis use and physical self-disgust could have bi-directional components and it would be useful to examine this using dynamic models. At present, our mediation model suggests that time since amputation (an exogenous variable) has a unidirectional effect on prosthesis use and self-disgust, and that variance in the use of the prosthesis may help to explain the one-way association between time since amputation and reduced physical self-disgust. However, the potentially reciprocal relationship between physical self-disgust and prosthesis use remains unexplored.

This study examined the relationship between self-disgust and prosthesis use after amputation, in a sample with largely lower limb amputations. Self-disgust was found to correlate significantly with frequency of prosthesis use and prosthesis satisfaction, and frequency of prosthesis use was significantly associated with physical self-disgust, with and without associated control variables. Furthermore, the frequency of prosthesis use statistically mediated the relationship between time since amputation and physical self-disgust, potentially helping to explain their association. We interpret these results as consistent with a "normalising" theory of prosthesis use, whereby correcting the body envelope and function has positive psychological benefits beyond functional utility. Clinical interventions that focus on increasing prosthesis use and/or addressing problematic levels of physical self-disgust are likely to be beneficial for the long-term psychological adjustment of those with lower-limb amputations.

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Table 1

Descriptive statistics for continuous measures

Variable	*N*	Mean (*SD*)	Median	Percentiles		Range	
				25	75	Possible	Actual
Age	82	52.44 (14.10)	53	19	39	-	18 – 78
Prosthesis use (hours / month)	79	379.28 (161.54)	434	279	496	0 – 744	0 – 558
Time since amputation (years)	83	12.25 (14.12)	7	3	20	-	0 – 48
Physical self-disgust (SDS-R)	83	11.47 (6.15)	9	6	15.25	5 – 35	5 – 31
Behavioural self-disgust (SDS-R)	83	9.82 (5.11)	8	6	12	5 – 35	5 – 30
Psychosocial adjustment (TAPES-R)	83	3.16 (0.57)	3.33	2.67	3.62	1 – 4	1.73 – 4
Prosthesis satisfaction (TAPES-R)	83	17.24 (4.60)	19	13	21	8 – 24	8 – 24
Body image disturbance (ABIS-R)[a]	82	7.43 (6.06)	5	2	13	0 – 26	0 – 25
Psychological distress (DASS-21)	81	20.35 (21.80)	14	4	28.50	0 – 126	0 – 100

Note. *N* varies based on instances of missing data. [a]Based on a 13-item version. ABIS-R = Amputee Body Image Scale-Revised; DASS-21 = Depression Anxiety and Stress Scales; SDS-R = Self-Disgust Scale-Revised; TAPES-R = Trinity Amputation and Prosthesis Experience Scales-Revised.

Table 2

Correlations between study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sex (1=Female)	-												
2. Age[a]	−.24*	-											
3. Ethnicity (1=Not white)	−.02	.06	-										
4. Accident (1=Yes)	.07	−.14	−.16	-									
5. Prosthesis use (hours / month)[a]	−.19†	.34**	−.13	.10	-								
6. Time since amputation (years)	.01	.18	−.06	.36**	.23*	-							
7. Psychosocial adjustment	−.06	.10	−.10	.17	.23*	.28*	-						
8. Satisfaction with prosthesis	−.12	.05	−.14	.14	.22*	.11	.67***	-					
9. Residual limb pain (1=Yes)	.09	−.08	−.09	.10	−.22*	.04	−.19†	−.20†	-				
10. Phantom limb pain (1=Yes)	−.17	.08	−.00	−.07	−.09	.04	−.10	−.17	.59***	-			
11. Body image disturbance	.18	−.24*	−.01	−.06	−.08	−.08	−.65***	−.67***	.24*	.19†	-		
12. Psychological distress[a]	.05	−.28**	.07	−.01	−.22†	−.18	−.56***	−.56***	.29**	.20†	.70***	-	
13. Physical self-disgust	.10	−.26*	−.09	−.09	−.31**	−.27*	−.56***	−.52***	.22*	.12	.67***	.64***	-
14. Behavioural self-disgust	−.03	−.29**	−.09	−.10	−.23*	−.08	−.42***	−.42***	.16	.17	.62***	.68***	.66***

Note. $N = 82$. [a]This variable contains imputed data. Correlations are Spearman's rho (*rs*), rank-biseral (r_{rb}), or phi (r_{Φ}) coefficients. †$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 3

Bootstrapped regression estimates

	Physical self-disgust										Behavioural self-disgust									
	Uncovaried analysis					Covaried analysis					Uncovaried analysis					Covaried analysis				
	R^2 = .11, adj. R^2 = .10, p = .002					R^2 = .64, adj. R^2 = .60, p < .001					R^2 = .03, adj. R^2 = .02, p = .105					R^2 = .58, adj. R^2 = .53, p < .001				
Variable	b	BCa 95% CI		β	*p*	b	BCa 95% CI		β	*p*	b	BCa 95% CI		β	*p*	b	BCa 95% CI		β	*p*
Prosthesis use (hours/month)[a]	−0.01	−0.02	−0.01	−.33	.001	−0.01	−0.02	−0.00	−.28	.005	−0.01	−0.01	0.00	−.18	.111	−0.01	−0.01	0.00	−.17	.100
Years since amputation						−0.02	−0.09	0.05	−.04	.640						0.04	−0.02	0.11	.11	.193
Age[a]						0.02	−0.05	0.09	.05	.514						0.02	−0.03	0.09	.07	.428
Psychosocial adjustment						−1.03	−3.80	0.63	−.09	.360						−0.37	−3.54	1.80	−.04	.789
Satisfaction with prosthesis						0.20	−0.13	0.57	.15	.264						0.18	−0.16	0.60	.16	.341
Residual limb pain (1=Yes)						−0.26	−1.85	1.34	−.02	.731						−0.73	−2.46	1.16	−.07	.403
Body image disturbance						0.66	0.38	0.90	.65	<.001						0.18	−0.07	0.42	.21	.210
Psychological distress[a]						0.05	−0.02	0.12	.16	.157						0.16	0.08	0.24	.67	<.001

Note. N = 82. [a]This variable contains imputed data. BCa 95% CIs = bias-corrected and accelerated bootstrap 95% confidence intervals. Probability values derived from BCa estimates (k = 10,000).

Table 4

Bootstrapped mediation estimates

Mediational effects (without covariates)	b	BCa 95% CI		β	*p*
(a) Years since amputation -> prosthesis use[a]	2.49	0.13	4.49	.22	.040
(b) Prosthesis use[a] -> physical self-disgust	−0.01	−0.02	−0.00	−.29	.014
(c) Prosthesis use[a] -> behavioural self-disgust	−0.01	−0.01	0.00	−.17	.179
(d) Years since amputation -> physical self-disgust	−0.08	−0.17	0.01	−.19	.060
(e) Years since amputation -> behavioural self-disgust	−0.02	−0.11	0.06	−.06	.622
(a)*(b)	−0.03	−0.07	−0.00	−.06	.022
(a)*(c)	−0.01	−0.04	0.00	−.04	.093
Mediational effects (with covariates)	b	BCa 95% CI		β	*p*
(f) Years since amputation -> prosthesis use[a]	1.93	−0.44	4.14	.17	.111
(g) Prosthesis use[a] -> physical self-disgust	−0.01	−0.02	−0.00	−.28	.005
(h) Prosthesis use[a] -> behavioural self-disgust	−0.01	−0.01	0.00	−.17	.096
(d) Years since amputation -> physical self-disgust	−0.02	−0.09	0.05	−.04	.603
(j) Years since amputation -> behavioural self-disgust	0.04	−0.02	0.10	.11	.207
(f)*(g)	−0.02	−0.05	−0.00	−.05	.035
(f)*(h)	−0.01	−0.03	0.00	−.03	.059

Note. $N = 82$. [a]This variable contains imputed data. BCa 95% CIs = bias-corrected and accelerated bootstrap 95% confidence intervals. Probability values derived from BCa estimates ($k = 10{,}000$). BCa confidence intervals and significance tests based on unstandardised estimates in AMOS.

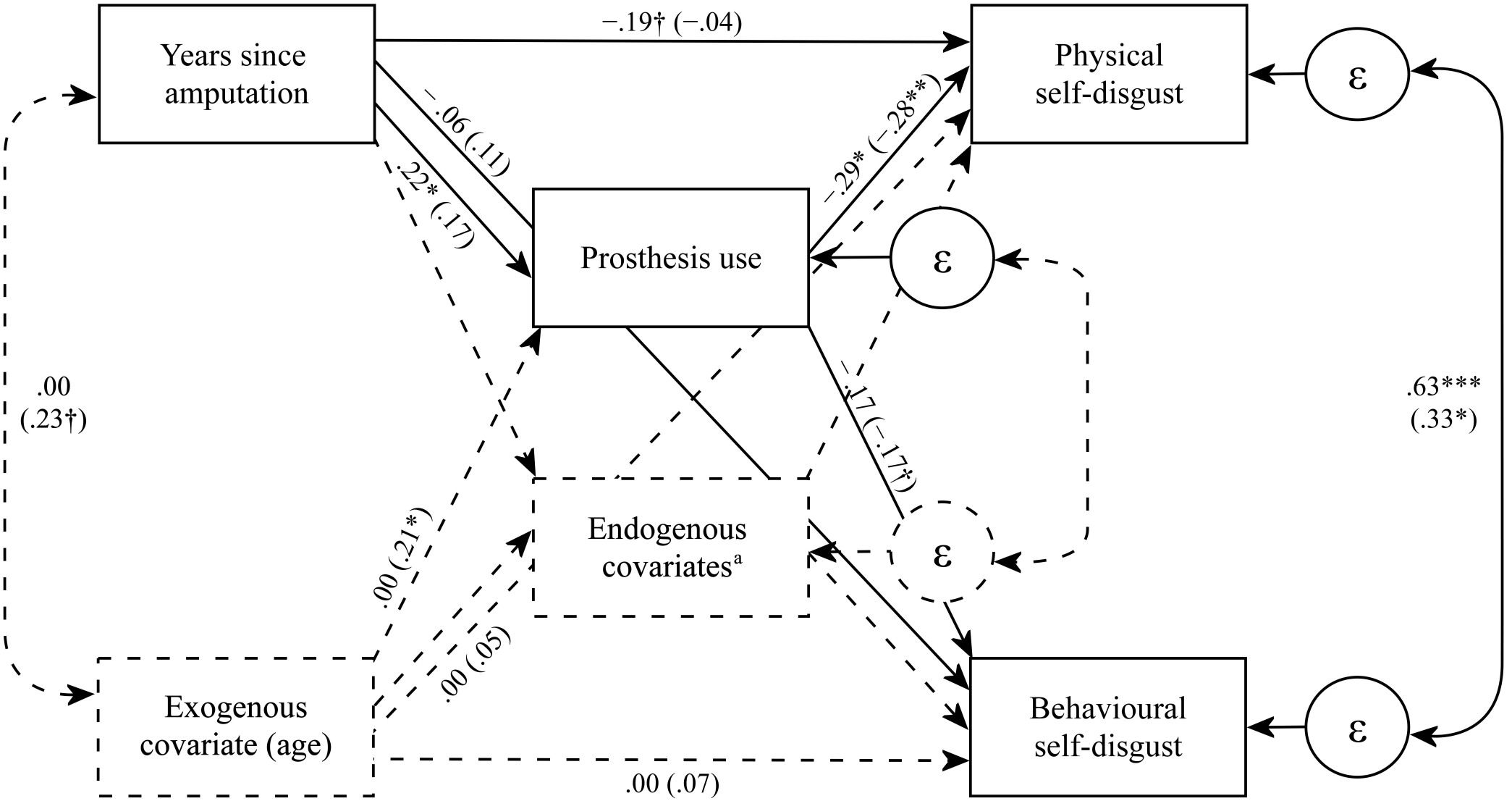
Years since amputation
Physical self-disgust
Prosthesis use
Endogenous covariates[a]
Exogenous covariate (age)
Behavioural self-disgust
ε
−.19† (−.04)
−.06 (.11)
.22* (.17)
−.29* (−.28**)
−.17 (−.17†)
.00 (.21*)
.00 (.05)
.00 (.07)
.00 (.23†)
.63*** (.33*)

Figure 1. Estimated mediation model. $N = 82$. Frequency of prosthesis use significantly mediated the exogenous effect of years since amputation on physical self-disgust, with, $\beta = -.05$, $p = .035$, and without, $\beta = -.06$, $p = .022$, controlling for other covariates. [a]Endogenous covariates in the model were: psychosocial adjustment, satisfaction with prosthesis, stump pain, body image disturbance, and psychological distress. In the uncovaried model, parameters associated with the covariates were constrained to zero. Estimates represent standardised beta weights, with the uncovaried estimates (solid arrows) outside and covaried estimates (dashed arrows) inside parentheses. Error terms between endogenous variables at similar levels of the mediation model were permitted to covary. Significance estimates based on the BCa bootstrap procedure (unstandardised estimates; $k = 10{,}000$). $^{\dagger}p < .10$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.