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Introduction

Our preference for ‘attractive’ faces is well-documented, and is present in infants from birth\(^1\). The preference continues through adulthood, with attractive individuals experiencing greater social\(^2\), occupational\(^3\), and dating\(^4\) success than their less attractive counterparts. Despite individual differences in the specifics of the faces that we each find attractive, we are generally consistent in identifying attractiveness\(^5\). According to evolutionary psychologists, our preference for attractive faces serves an adaptive function: encouraging us to choose high-quality mates for the propagation of our genes. We show consistent preferences, for example, for cues to good health in the face (e.g. symmetry\(^6\) and averageness\(^7\)). We also tend to perceive younger adult faces as more attractive than older faces, perhaps due to the link between youth and fertility\(^8\).

Given the value we attribute to attractiveness and a youthful appearance, it is no surprise that facial rejuvenation approaches target signs of aging\(^9\). During aging, upper facial regions lose collagen and elasticity, causing skin sagging\(^10\). Repetitive muscular contraction leads to the development of upper dynamic facial lines, predominantly in the glabellar (“frown”), forehead (“raise eyebrows”) and crows feet (“big smile”) areas\(^11\). These areas, then, have been the target of rejuvenation techniques, among which Botulinum Toxin Type A (BoNT-A) is the most popular non-surgical treatment worldwide (Fink & Prager, 2014). This non-invasive injectable acts as a muscle relaxant, blocking the release of the neurotransmitter acetylcholine; a key messenger for muscle contractions\(^12\), so reducing or eradicating the appearance of upper dynamic facial lines for 8 to 12 weeks, and can also be used to correct
asymmetry and raise the brow (Dayan, Arkins, Patel & Gal, 2010). The popularity of BoNT-A treatments is evidenced by 80-90% of patients reporting satisfaction with their treatment, and many stating they would recommend the treatment to others (Sommer et al, 2003; see Fagien & Carruthers, 2008 for a comprehensive review).

In addition to satisfaction with appearance post-treatment, there is a growing body of evidence that treatment with BoNT-A results in improved psychological outcomes, such as self-esteem. Lewis and Bowler, for example, report that patients treated with BoNT-A had significantly better mood than those treated with another cosmetic procedure. According to Jandhyala, however, the most powerful way to assess the effect of BoNT-A on patient psychological wellbeing is to compare validated measures before and after treatment. Dayan et al, for example, in their double blind, randomized, placebo-controlled study demonstrated that participants treated with BoNT-A showed a significant improvement in self-reported measures on standardized scales of quality of life and self-esteem, compared to those in a placebo group (i.e. injected with saline).

Dayan et al argue that the psychological effects of BoNT-A exist for one of two reasons: (1) the physical improvement of patient’s wrinkle concerns contributes to self-esteem, or (2) more favorable treatment from others, as a result of BoNT-A, encourages greater self-esteem. Both of these seem plausible, particularly in light of the human preferences for attractive faces discussed above. Thus, perhaps the effects of BoNT-A involve an interaction between both mechanisms, wherein a patient treated with BoNT-A experiences increased satisfaction with their appearance directly which, in turn (and in combination with putative direct effects of BoNT-A on
attractiveness), causes them to interact more positively with others, leading them to be perceived as more attractive. This attractiveness preference may then encourage more favourable treatment towards the BoNT-A patient, reinforcing the boost to self-esteem. Subjective patient reports support this assumption; with patients revealing that they felt others treated them more favourably following BoNT-A treatment. Indeed, there is even evidence that faces treated with BoNT-A are perceived as more positive for predicted academic performance, occupation, dating and athletic success, and attractiveness.

To summarise, BoNT-A improves objectively rated facial attractiveness which may contribute to BoNT-A patients’ improved psychological wellbeing following treatment. However, no previous work has assessed the same patient sample (i.e. patient self-esteem and other’s perception of that patient post-BoNT-A) in order to make these inferences. Our study, then, is a controlled experiment using validated psychological measures and pre- and post-treatment comparison to test the following predictions: (1) treatment with BoNT-A will improve psychological wellbeing; (2) treatment with BoNT-A will improve attractiveness rated by self and others; (3) attractiveness rated by self and others will mediate the effects of BoNT-A on psychological wellbeing.

We tested the predictions in a sample of female participants using a repeated-measures design. We measured self-esteem, satisfaction with life, and self-rated attractiveness prior to, and 4 weeks (+/- 3 days) post, BoNT-A treatment. We took facial photographs at both time points, and these were rated for attractiveness by participants who were unfamiliar with those in the photographs.
Methods

Participants
We recruited 32 female participants aged 27 to 72 (mean = 41.66, SD = 12.48) from Fresh Inc MediSpa, Invergowrie, Scotland. Volunteers were denied participation if they had a medical condition that would contraindicate BoNT-A treatment, the presenting lines were not suitable for BoNT-A treatment, or they had previously received a treatment that would interfere with BoNT-A’s treatment outcome. For 7 participants (21.88%) this was their first treatment with BoNT-A. The remainder (78.12%) had not been treated in the past 6 months.

Materials
Participants receiving BoNT-A treatment completed standardised measures of self-esteem, satisfaction with life, and self-rated attractiveness.

Self-esteem was assessed using Rosenberg’s Self-Esteem Questionnaire, which includes statements such as ‘On the whole, I am satisfied with myself’ and provides a measure of the extent to which an individual values themselves.

Satisfaction with Life was measured using Deiner’s Satisfaction with Life Questionnaire, which is a five-item questionnaire, including items such as ‘In most ways my life is close to my ideal’.
To assess self-rated attractiveness before and after treatment, patients were simply asked ‘How attractive do you perceive yourself to be?’ Responses were scored on a five-point scale, ranging from unattractive (scored as 1) to attractive (scored as 5). This is standard in the facial attractiveness literature\(^5\).

Facial attractiveness

Facial images were collected using an iPhone 5S camera, at 1m distance from the patient, against a white background and under standardised lighting. We instructed participants to wear consistent makeup and hairstyles for photographs taken pre- and post-treatment, and to maintain a neutral facial expression. Facial images were masked using Psychomorph software\(^2\) to disguise clothes, hair, and jewellery. Thirty-one participants provided consent for their photos to be rated for attractiveness pre- and post-treatment.

Raters were 22 men and 78 women (mean age = 28.51, S.D. = 11.39) recruited via social media from the Universities of Liverpool and Nottingham Trent, in order to avoid familiarity with participants in the BoNT-A trial. We provided participants with a link which allocated them at random to rate either the pre-treatment or post-treatment faces. There were 50 raters for each set of images. Faces were presented in random order via an online survey, and raters were asked to rate each face from 1 (very unattractive) to 7 (very attractive). Raters were naïve to the purpose of the study and were not informed that either condition consisted of post-BoNT-A images. They were fully debriefed at the end of the study.

Procedure
The study received full approval from the University of Dundee Research Ethics Committee and the owner and manager of Fresh Inc MediSpa.

In-clinic appointments were scheduled for patients who expressed an interest in participating in the study. Patients were required to attend the clinic on three occasions. **Session 1:** We presented potential participants the clinic’s ‘General Consultation Questionnaire’ and Azzalure’s™ Treatment Consent Form in accordance with clinic protocol. Upon completion, patients were seen by the in-house General Practitioner (GP) to assess their medical fitness for BoNT-A treatment. Once GP approval was given, we provided participants with a Participant Information Sheet and Consent Form, and obtained consent from the GP and Senior Practitioner. Participants completed the psychological wellbeing measures followed by facial photography. We then took them to the treatment room for the BoNT-A therapy. To ensure consistency of treatment procedure, the senior practitioner conducted all BoNT-A treatments. Each vial containing 125 speywood units of Azzalure (Galderma) was diluted with 0.63ml of Bacteriostatic Saline, following reconstitution directions as instructed in Azzalure’s manual24. There was no standardized treatment protocol, and injections depended upon participants’ muscle activity, depth of lines and the areas treated. Therefore, a record was kept of the number of areas treated, and the units injected, for each participant. Treatment areas were limited to the glabellar area, forehead and crow’s feet.

**Session 2:** Participants returned to the clinic 2-weeks post BoNT-A treatment for a scheduled review. Any further injections, if required, were administered at this stage.
Session 3: Patients returned to the clinic 4-weeks (+/- 3 days) after the initial BoNT-A treatment. Participants completed measures of psychological wellbeing and had their photograph taken as for Session 1. Participants were then fully debriefed.

Results

Table 1 Means (and standard deviations) for all variables, and Spearman’s correlation coefficients for relationships between all variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41.66 (12.48)</td>
</tr>
<tr>
<td>2. Units</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>138.88 (42.6)</td>
</tr>
<tr>
<td>3. Areas treated</td>
<td>-.03</td>
<td>.68*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.53 (0.67)</td>
</tr>
<tr>
<td>4. Self-esteem change</td>
<td>.13</td>
<td>.01</td>
<td>-.04</td>
<td></td>
<td></td>
<td></td>
<td>4.91 (4.35)</td>
</tr>
<tr>
<td>5. SWL change</td>
<td>.08</td>
<td>-.11</td>
<td>-.12</td>
<td>.59*</td>
<td></td>
<td></td>
<td>6 (4.98)</td>
</tr>
<tr>
<td>6. Self-rated attractiveness change</td>
<td>.09</td>
<td>.07</td>
<td>.1</td>
<td>.7*</td>
<td>.59*</td>
<td></td>
<td>1.28 (1.11)</td>
</tr>
<tr>
<td>7. Other-rated attractiveness change</td>
<td>-.25</td>
<td>0.01</td>
<td>0.14</td>
<td>0.24</td>
<td>0.09</td>
<td>0.1</td>
<td>1.25 (0.42)</td>
</tr>
</tbody>
</table>

* p < 0.001

All variables were within specified parameters of normality, so parametric analyses were employed. As age, number of areas treated, and number of units injected were
not correlated with the variables of interest (all $p > 0.09$), we did not include these in further analyses.

Does treatment with BoNT-A improve psychological wellbeing?

In bivariate regression models, a treatment level dummy variable ($0 = $ pre-treatment, $1 = $ post-treatment) was found to significantly predict self-esteem ($\text{Adj } R^2 = 0.24$, $F(1, 62) = 20.4$, $p < 0.001$, $\beta = 0.5$, $p < 0.001$) and satisfaction with life ($\text{Adj } R^2 = 0.22$, $F(1, 62) = 18.27$, $p < 0.001$, $\beta = 0.48$, $p < 0.001$), such that both were significantly higher post-treatment. Figure 1 shows the significant effects of treatment on self-esteem and satisfaction with life.

Does treatment with BoNT-A improve attractiveness rated by self and others?

In bivariate regression models, a treatment level dummy variable ($0 = $ pre-treatment, $1 = $ post-treatment) was found to significantly predict attractiveness rated by self ($\text{Adj } R^2 = 0.36$, $F(1, 62) = 35.72$, $p < 0.001$, $\beta = 0.61$, $p < 0.001$) and attractiveness rated by others ($\text{Adj } R^2 = 0.49$, $F(1, 60) = 58.63$, $p < 0.001$, $\beta = 0.7$, $p < 0.001$), such that both were significantly higher post-treatment. Figure 2 shows the significant effects of treatment on attractiveness rated by both self and others.
Does attractiveness mediate the effects of treatment with BoNT-A on psychological wellbeing?

As described above, treatment significantly predicted psychological wellbeing and attractiveness. In order to determine whether attractiveness mediated the effects of treatment on psychological wellbeing, we first tested for bivariate relationships between measures of psychological wellbeing and attractiveness. Self-rated attractiveness significantly predicted self-esteem (Adj $R^2 = 0.46$, $F(1, 62) = 54.85$, $p < 0.001$, $\beta = 0.69$, $p < 0.001$) and satisfaction with life (Adj $R^2 = 0.22$, $F(1, 62) = 18.95$, $p < 0.001$, $\beta = 0.48$, $p < 0.001$), and attractiveness rated by others significantly predicted self-esteem (Adj $R^2 = 0.20$, $F(1, 60) = 16.56$, $p < 0.001$, $\beta = 0.47$, $p < 0.001$) and satisfaction with life (Adj $R^2 = 0.14$, $F(1, 60) = 11.24$, $p < 0.001$, $\beta = 0.4$, $p = 0.001$). In all cases, higher attractiveness ratings were associated with more positive psychological wellbeing.

When self-rated attractiveness and treatment level were entered as simultaneous predictors in the model, with self-esteem as the criterion (Adj $R^2 = 0.46$, $F(1, 61) = 28.19$, $p < 0.001$), treatment level lost significance ($\beta = 0.13$, $p = 0.261$) and self-rated attractiveness maintained significance ($\beta = 0.61$, $p < 0.001$). Therefore, self-rated attractiveness mediated the effect of treatment on self-esteem. Figure 3 shows this mediating relationship.

When attractiveness rated by others and treatment level were entered as simultaneous predictors in the model, with self-esteem as the criterion (Adj $R^2 = 0.26$, $F(1, 59) =$
11.93, \( p < 0.001 \), treatment level maintained significance \( (\beta = 0.38, \ p = 0.018) \) and attractiveness rated by others lost significance \( (\beta = 0.2, \ p = 0.199) \). Therefore, attractiveness rated by others did not mediate the effect of treatment on self-esteem.

When attractiveness rated by self and treatment level were entered as simultaneous predictors in the model, with satisfaction with life as the criterion (Adj \( R^2 = 0.26, F(1, 61) = 12.32, p < 0.001 \)), treatment level maintained significance \( (\beta = 0.29, \ p = 0.036) \), and so too did self-rated attractiveness \( (\beta = 0.31, \ p = 0.027) \). Therefore, attractiveness rated by self did not mediate the effect of treatment on satisfaction with life.

Finally, when attractiveness rated by others and treatment level were entered as simultaneous predictors in the model, with satisfaction with life as the criterion (Adj \( R^2 = 0.21, F(1, 59) = 9, p < 0.001 \)), treatment level maintained significance \( (\beta = 0.39, \ p = 0.019) \), and attractiveness rated by others lost significance \( (\beta = 0.39, \ p = 0.44) \). Therefore, attractiveness rated by others did not mediate the effect of treatment on satisfaction with life.

Table 2 summarises all results.

Table 2 about here

Discussion

Here we have shown that treatment with BoNT-A results in significant improvements to psychological wellbeing (self-esteem and satisfaction with life) and attractiveness
(as rated by self and others), and that the effects of treatment on self-esteem occur via the effects of treatment on attractiveness rated by self.

Our results are consistent with previous work which has reported benefits of BoNT-A for psychological well-being\textsuperscript{e.g.14}. Our study, however, was also able to detect positive effects on wellbeing that extended those beyond quality of life measures specific to cosmetic treatment, and demonstrate that treatment with BoNT-A has benefits on life satisfaction more broadly. Furthermore, our study was the first to test the effects of BoNT-A on attractiveness rated by self and others, and to determine whether it was these effects which, in turn, accounted for the positive influence of treatment on psychological wellbeing.

As we argued earlier, there are 2 pathways by which effects of BoNT-A on attractiveness may be translated into effects on psychological wellbeing. In the first, individuals who are perceived as ‘attractive’ may receive more favourable treatment from others which, in turn, may provide an intermediate ‘mediating’ step between treatment with BoNT-A and psychological wellbeing: if treatment causes others to perceive the individual as more attractive and, therefore, treat them more favourably in social interactions, this may lead to improved psychological wellbeing\textsuperscript{20}. Our analyses, however, failed to detect this effect, as attractiveness rated by others did not mediate relationships between treatment and self-esteem or satisfaction with life. In the second, the positive effects of treatment with BoNT-A on self-rated attractiveness are responsible for the positive effects of treatment on psychological wellbeing: given the value placed on ‘attractiveness’, feeling more attractive is predicted to boost an individual’s psychological wellbeing. We found support for this as self-rated
attractiveness mediated the effects of treatment on self-esteem. In other words, treatment improves self-rated attractiveness which, in turn, improves self-esteem. We did not find a mediating role of self-rated attractiveness in the effect of treatment on satisfaction with life, and it may be that this variable is too broad and comprised of too much that is external to, and unaffected by, physical appearance for such effects to be detected. Indeed, Dayan et al\textsuperscript{20} argue that a fundamental facet of self-esteem is an individual’s attitude to their own aesthetic appearance. If they are dissatisfied with how they look, or consider themselves unattractive, they are more likely to possess low self-esteem. Our results support this, and show that treatment with BoNT-A have a positive influence on self-perceived attractiveness and, in turn, self-esteem.

Results of the current study are encouraging for the field of aesthetic medicine, highlighting the success of BoNT-A for the improvement of psychological wellbeing. We acknowledge, however, that a placebo-controlled double blind methodology would provide a more rigorous test of our predictions. We suggest that future work should test the pathways we have identified here in clinical populations that are characterized by low self-esteem (e.g. eating disorders and depression).

In conclusion, we have demonstrated that treatment with BoNT-A results in significant improvements to psychological wellbeing (self-esteem and satisfaction with life) and attractiveness (as rated by self and others), and that the effects of treatment on self-esteem occur via the effects of treatment on self-rated attractiveness. We conclude that treatment with BoNT-A has benefits for psychological wellbeing and facial appearance, both as perceived by the self and by others.
Acknowledgements

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References


Figure 1 Showing mean self-esteem (left) and satisfaction with life (right) in participants pre- and post-treatment (error bars are +/− 1 SE)
Figure 2 Showing mean self-rated (left) and other-rated (right) attractiveness in participants pre- and post-treatment (error bars are +/- 1 SE).

Figure 3 Mediation model showing beta coefficients for treatment with BoNT-A and self-rated attractiveness in predicting self-esteem. The c path represents the effect of treatment on self-esteem without the mediator (total effect) and the c’ path is the effect of treatment on self-esteem after accounting for the mediator (direct effect). *p < 0.01.