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1 **Introduction**

2

3 Our preference for ‘attractive’ faces is well-documented, and is present in infants
4 from birth¹. The preference continues through adulthood, with attractive individuals
5 experiencing greater social², occupational³, and dating⁴ success than their less
6 attractive counterparts. Despite individual differences in the specifics of the faces that
7 we each find attractive, we are generally consistent in identifying attractiveness⁵.
8 According to evolutionary psychologists, our preference for attractive faces serves an
9 adaptive function: encouraging us to choose high-quality mates for the propagation of
10 our genes. We show consistent preferences, for example, for cues to good health in
11 the face (e.g. symmetry⁶ and averageness⁷). We also tend to perceive younger adult
12 faces as more attractive than older faces, perhaps due to the link between youth and
13 fertility⁸.

14

15 Given the value we attribute to attractiveness and a youthful appearance, it is no
16 surprise that facial rejuvenation approaches target signs of aging⁹. During aging,
17 upper facial regions lose collagen and elasticity, causing skin sagging¹⁰. Repetitive
18 muscular contraction leads to the development of upper dynamic facial lines,
19 predominantly in the glabellar (“frown”), forehead (“raise eyebrows”) and crows feet
20 (“big smile”) areas¹¹. These areas, then, have been the target of rejuvenation
21 techniques, among which Botulinum Toxin Type A (BoNT-A) is the most popular
22 non-surgical treatment worldwide (Fink & Prager, 2014). This non-invasive injectable
23 acts as a muscle relaxant, blocking the release of the neurotransmitter acetylcholine; a
24 key messenger for muscle contractions¹², so reducing or eradicating the appearance of
25 upper dynamic facial lines for 8 to 12 weeks, and can also be used to correct

26 asymmetry and raise the brow (Dayan, Arkins, Patel & Gal, 2010). The popularity of
27 BoNT-A treatments is evidenced by 80-90% of patients reporting satisfaction with
28 their treatment, and many stating they would recommend the treatment to others
29 (Sommer et al, 2003; see Fagien & Carruthers, 2008 for a comprehensive review).

30

31 In addition to satisfaction with appearance post-treatment, there is a growing body of
32 evidence that treatment with BoNT-A results in improved psychological outcomes,
33 such as self-esteem¹⁷. Lewis and Bowler¹⁸, for example, report that patients treated
34 with BoNT-A had significantly better mood than those treated with another cosmetic
35 procedure. According to Jandhyala¹⁹, however, the most powerful way to assess the
36 effect of BoNT-A on patient psychological wellbeing is to compare validated
37 measures before and after treatment. Dayan et al¹⁴, for example, in their double blind,
38 randomized, placebo-controlled study demonstrated that participants treated with
39 BoNT-A showed a significant improvement in self-reported measures on standardized
40 scales of quality of life and self-esteem, compared to those in a placebo group (i.e.
41 injected with saline).

42

43 Dayan et al¹⁴ argue that the psychological effects of BoNT-A exist for one of two
44 reasons: (1) the physical improvement of patient's wrinkle concerns contributes to
45 self-esteem, or (2) more favorable treatment from others, as a result of BoNT-A,
46 encourages greater self-esteem. Both of these seem plausible, particularly in light of
47 the human preferences for attractive faces discussed above. Thus, perhaps the effects
48 of BoNT-A involve an interaction between both mechanisms, wherein a patient
49 treated with BoNT-A experiences increased satisfaction with their appearance directly
50 which, in turn (and in combination with putative direct effects of BoNT-A on

51 attractiveness), causes them to interact more positively with others, leading them to be
52 perceived as more attractive. This attractiveness preference may then encourage more
53 favourable treatment towards the BoNT-A patient, reinforcing the boost to self-
54 esteem. Subjective patient reports support this assumption; with patients revealing
55 that they felt others treated them more favourably following BoNT-A treatment²⁰.
56 Indeed, there is even evidence that faces treated with BoNT-A are perceived as more
57 positive for predicted academic performance, occupation, dating and athletic success,
58 and attractiveness²⁰.

59

60 To summarise, BoNT-A improves objectively rated facial attractiveness^{13,20} which
61 may contribute to BoNT-A patients' improved psychological wellbeing following
62 treatment. However, no previous work has assessed the same patient sample (i.e.
63 patient self-esteem and other's perception of that patient post-BoNT-A) in order to
64 make these inferences. Our study, then, is a controlled experiment using validated
65 psychological measures and pre- and post-treatment comparison to test the following
66 predictions: (1) treatment with BoNT-A will improve psychological wellbeing; (2)
67 treatment with BoNT-A will improve attractiveness rated by self and others; (3)
68 attractiveness rated by self and others will mediate the effects of BoNT-A on
69 psychological wellbeing.

70

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

76

77 **Methods**

78

79 **Participants**

80 We recruited 32 female participants aged 27 to 72 (mean = 41.66, SD = 12.48) from
81 Fresh Inc MediSpa, Invergowrie, Scotland. Volunteers were denied participation if
82 they had a medical condition that would contraindicate BoNT-A treatment, the
83 presenting lines were not suitable for BoNT-A treatment, or they had previously
84 received a treatment that would interfere with BoNT-A's treatment outcome. For 7
85 participants (21.88%) this was their first treatment with BoNT-A. The remainder
86 (78.12%) had not been treated in the past 6 months.

87

88 **Materials**

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

91

92 Self-esteem was assessed using Rosenberg's²¹ Self-Esteem Questionnaire, which
93 includes statements such as 'On the whole, I am satisfied with myself' and provides a
94 measure of the extent to which an individual values themselves.

95

96 Satisfaction with Life was measured using Deiner's Satisfaction with Life
97 Questionnaire²², which is a five-item questionnaire, including items such as 'In most
98 ways my life is close to my ideal'.

99

100 To assess self-rated attractiveness before and after treatment, patients were simply
101 asked ‘How attractive do you perceive yourself to be?’ Responses were scored on a
102 five-point scale, ranging from unattractive (scored as 1) to attractive (scored as 5).
103 This is standard in the facial attractiveness literature^{e.g. 5}.

104

105 *Facial attractiveness*

106 Facial images were collected using an iPhone 5S camera, at 1m distance from the
107 patient, against a white background and under standardised lighting. We instructed
108 participants to wear consistent makeup and hairstyles for photographs taken pre- and
109 post-treatment, and to maintain a neutral facial expression. Facial images were
110 masked using Psychomorph software²³ to disguise clothes, hair, and jewellery. Thirty-
111 one participants provided consent for their photos to be rated for attractiveness pre-
112 and post-treatment.

113

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

123

124 **Procedure**

125

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

128

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

147

148 *Session 2:* Participants returned to the clinic 2-weeks post BoNT-A treatment for a
149 scheduled review. Any further injections, if required, were administered at this stage.

150

151 *Session 3:* Patients returned to the clinic 4-weeks (+/- 3 days) after the initial BoNT-A
152 treatment. Participants completed measures of psychological wellbeing and had their
153 photograph taken as for Session 1. Participants were then fully debriefed.

154

155 **Results**

156

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

159

Variable	1.	2.	3.	4.	5.	6.	Mean (SD)
1. Age							41.66 (12.48)
2. Units	0.06						138.88 (42.6)
3. Areas treated	-.03	.68*					2.53 (0.67)
4. Self-esteem change	.13	.01	-.04				4.91 (4.35)
5. SWL change	.08	-.11	-.12	.59*			6 (4.98)
6. Self-rated attractiveness change	.09	.07	.1	.7*	.59*		1.28 (1.11)
7. Other-rated attractiveness change	-0.25	0.01	0.14	0.24	0.09	0.1	1.25 (0.42)

* p < 0.001

160

161 All variables were within specified parameters of normality, so parametric analyses
162 were employed. As age, number of areas treated, and number of units injected were

163 not correlated with the variables of interest (all $p > 0.09$), we did not include these in
164 further analyses.

165

166 *Does treatment with BoNT-A improve psychological wellbeing?*

167

168 In bivariate regression models, a treatment level dummy variable (0 = pre-treatment, 1
169 = post-treatment) was found to significantly predict self-esteem (Adj $R^2 = 0.24$, $F(1,$
170 $62) = 20.4$, $p < 0.001$, $\beta = 0.5$, $p < 0.001$) and satisfaction with life (Adj $R^2 = 0.22$, $F(1,$
171 $62) = 18.27$, $p < 0.001$, $\beta = 0.48$, $p < 0.001$), such that both were significantly higher
172 post-treatment. Figure 1 shows the significant effects of treatment on self-esteem and
173 satisfaction with life.

174

175 Figure 1 about here.

176

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

178

179 In bivariate regression models, a treatment level dummy variable (0 = pre-treatment, 1
180 = post-treatment) was found to significantly predict attractiveness rated by self (Adj
181 $R^2 = 0.36$, $F(1, 62) = 35.72$, $p < 0.001$, $\beta = 0.61$, $p < 0.001$) and attractiveness rated by
182 others (Adj $R^2 = 0.49$, $F(1, 60) = 58.63$, $p < 0.001$, $\beta = 0.7$, $p < 0.001$), such that both
183 were significantly higher post-treatment. Figure 2 shows the significant effects of
184 treatment on attractiveness rated by both self and others.

185

186 Figure 2 about here.

187

188 *Does attractiveness mediate the effects of treatment with BoNT-A on psychological*
189 *wellbeing?*

190 As described above, treatment significantly predicted psychological wellbeing and
191 attractiveness. In order to determine whether attractiveness mediated the effects of
192 treatment on psychological wellbeing, we first tested for bivariate relationships
193 between measures of psychological wellbeing and attractiveness. Self-rated
194 attractiveness significantly predicted self-esteem (Adj $R^2 = 0.46$, $F(1, 62) = 54.85$, $p <$
195 0.001 , $\beta = 0.69$, $p < 0.001$) and satisfaction with life (Adj $R^2 = 0.22$, $F(1, 62) = 18.95$,
196 $p < 0.001$, $\beta = 0.48$, $p < 0.001$), and attractiveness rated by others significantly
197 predicted self-esteem (Adj $R^2 = 0.2$, $F(1, 60) = 16.56$, $p < 0.001$, $\beta = 0.47$, $p < 0.001$)
198 and satisfaction with life (Adj $R^2 = 0.14$, $F(1, 60) = 11.24$, $p < 0.001$, $\beta = 0.4$, $p =$
199 0.001). In all cases, higher attractiveness ratings were associated with more positive
200 psychological wellbeing.

201

202 When self-rated attractiveness and treatment level were entered as simultaneous
203 predictors in the model, with self-esteem as the criterion (Adj $R^2 = 0.46$, $F(1, 61) =$
204 28.19 , $p < 0.001$), treatment level lost significance ($\beta = 0.13$, $p = 0.261$) and self-rated
205 attractiveness maintained significance ($\beta = 0.61$, $p < 0.001$). Therefore, self-rated
206 attractiveness mediated the effect of treatment on self-esteem. Figure 3 shows this
207 mediating relationship.

208

209 Figure 3 about here.

210

211 When attractiveness rated by others and treatment level were entered as simultaneous
212 predictors in the model, with self-esteem as the criterion (Adj $R^2 = 0.26$, $F(1, 59) =$

213 11.93, $p < 0.001$), treatment level maintained significance ($\beta = 0.38$, $p = 0.018$) and
214 attractiveness rated by others lost significance ($\beta = 0.2$, $p = 0.199$). Therefore,
215 attractiveness rated by others did not mediate the effect of treatment on self-esteem.

216

217 When attractiveness rated by self and treatment level were entered as simultaneous
218 predictors in the model, with satisfaction with life as the criterion (Adj $R^2 = 0.26$, $F(1,$
219 $61) = 12.32$, $p < 0.001$), treatment level maintained significance ($\beta = 0.29$, $p = 0.036$),
220 and so too did self-rated attractiveness ($\beta = 0.31$, $p = 0.027$). Therefore, attractiveness
221 rated by self did not mediate the effect of treatment on satisfaction with life.

222

223 Finally, when attractiveness rated by others and treatment level were entered as
224 simultaneous predictors in the model, with satisfaction with life as the criterion (Adj
225 $R^2 = 0.21$, $F(1, 59) = 9$, $p < 0.001$), treatment level maintained significance ($\beta = 0.39$,
226 $p = 0.019$), and attractiveness rated by others lost significance ($\beta = 0.39$, $p = 0.44$).
227 Therefore, attractiveness rated by others did not mediate the effect of treatment on
228 satisfaction with life.

229

230 Table 2 summarises all results.

231

232 Table 2 about here

233 **Discussion**

234

235 Here we have shown that treatment with BoNT-A results in significant improvements
236 to psychological wellbeing (self-esteem and satisfaction with life) and attractiveness

237 (as rated by self and others), and that the effects of treatment on self-esteem occur via
238 the effects of treatment on attractiveness rated by self.

239

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

248

249 As we argued earlier, there are 2 pathways by which effects of BoNT-A on
250 attractiveness may be translated into effects on psychological wellbeing. In the first,
251 individuals who are perceived as 'attractive' may receive more favourable treatment
252 from others which, in turn, may provide an intermediate 'mediating' step between
253 treatment with BoNT-A and psychological wellbeing: if treatment causes others to
254 perceive the individual as more attractive and, therefore, treat them more favourably
255 in social interactions, this may lead to improved psychological wellbeing²⁰. Our
256 analyses, however, failed to detect this effect, as attractiveness rated by others did not
257 mediate relationships between treatment and self-esteem or satisfaction with life. In
258 the second, the positive effects of treatment with BoNT-A on self-rated attractiveness
259 are responsible for the positive effects of treatment on psychological wellbeing: given
260 the value placed on 'attractiveness', feeling more attractive is predicted to boost an
261 individual's psychological wellbeing. We found support for this as self-rated

262 attractiveness mediated the effects of treatment on self-esteem. In other words,
263 treatment improves self-rated attractiveness which, in turn, improves self-esteem. We
264 did not find a mediating role of self-rated attractiveness in the effect of treatment on
265 satisfaction with life, and it may be that this variable is too broad and comprised of
266 too much that is external to, and unaffected by, physical appearance for such effects to
267 be detected. Indeed, Dayan et al²⁰ argue that a fundamental facet of self-esteem is an
268 individual's attitude to their own aesthetic appearance. If they are dissatisfied with
269 how they look, or consider themselves unattractive, they are more likely to possess low
270 self-esteem. Our results support this, and show that treatment with BoNT-A have a
271 positive influence on self-perceived attractiveness and, in turn, self-esteem.

272

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

279

280

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

287

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289

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292

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379
- 380 Figure 1 Showing mean self-esteem (left) and satisfaction with life (right) in
381 participants pre- and post-treatment (error bars are +- 1 SE)

382

383 Figure 2 Showing mean self-rated (left) and other-rated (right) attractiveness in

384 participants pre- and post-treatment (error bars are ± 1 SE)

385

386 Figure 3 Mediation model showing beta coefficients for treatment with BoNT-A and

387 self-rated attractiveness in predicting self-esteem. The c path represents the effect of

388 treatment on self-esteem without the mediator (total effect) and the c' path is the

389 effect of treatment on self-esteem after accounting for the mediator (direct effect). * p

390 < 0.01 .

391

392