How the harsh environment of an army training camp changes human (*Homo sapiens*) facial preferences

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Abstract

Previous studies suggest that facial preferences may be contingent on an individual's environment, yet no study has traced how the preferences of the same individuals change as their environment changes. We therefore sought to determine if, and to what extent, adiposity and masculinity preferences are malleable by repeatedly testing students whose environment was not changing as well students undergoing intensive training at an army camp. Our results showed that at baseline, the students at the training camp preferred more feminine male faces. This suggests that even before the training commenced, participants in the training camp may have been in a psychological state that predisposed them to prefer more trustworthy (i.e., more feminine) men. Additionally, we found that the students at the training camp reported increases in multiple stressors as well as showed changes in adiposity preferences. More specifically, we found that increases in the harshness of the environment led to an increased male attraction to cues of higher weight in female faces. Such changes in preferences may be adaptive because they allow men more opportunities to mate with women who are better equipped to survive and reproduce. These findings thus provide new evidence for the malleability of preferences depending on the environment.

Keywords: adiposity; masculinity; faces; preferences; environment

1. Introduction

Research suggests that partner preferences are malleable (Swami & Tovée 2006), being influenced by a myriad of factors, including environmental hardship (Batres & Perrett 2014). An individual's capacity to change their preferences according to their environment may be adaptive since partnership and alliance choices are crucial for economic, physical, and psychological wellbeing. Additionally, partner choice influences an individual's reproductive outcome and therefore altering partner preferences according to the environment may confer evolutionary benefits.

One preference that has been identified to alter between environments is that for weight. Underweight individuals have iron deficiencies (Brown et al. 2000), compromised immunity (Dirks & Leeuwenburgh 2006), and are at a higher risk for infections (Sullivan et al. 1990) when compared to individuals with healthy weights. On the other hand, overweight individuals are more likely to suffer from hypertension (Brown et al. 2000), asthma (Brown et al. 2000), and are also at higher risk for infections (Falagas & Kampoti 2006) when compared to individuals with healthy weights. Weight has also been linked to reproductive health in women with underweight individuals experiencing more miscarriages (Brown et al. 2000) and both underweight and overweight individuals having an increased risk of ovulatory infertility (Grodstein et al. 1994) and reporting menstruation irregularities (Brown et al. 2000). Given the health risks associated with both underweight and overweight statuses (Brown et al. 2000; Dirks & Leeuwenburgh 2006; Sullivan et al. 1990; Grodstein et al. 1994), it would be adaptive for weight preferences to fall within a healthy range, with some variation of preferences depending on the environment.

Harsh environments have been associated with a preference for cues to higher weights (Tovée et al. 2006; Batres & Perrett 2014). For example, Tovée, et al. (2006) found that

Zulus from South Africa prefer female figures with higher body mass than Caucasians from the United Kingdom. Moreover, they found that Zulus who had recently immigrated to the United Kingdom had preferences intermediate between those of Zulus residing in South Africa and Caucasians residing in the United Kingdom. The relationship between environmental harshness and weight preferences, however, is complex (Pettijohn & Tesser 1999; Pettijohn & Jungeberg 2004). For instance, Webster (2008) found that heavier women were preferred during prosperous economic markets while women with lower body mass indices (BMIs) were preferred during times of existential threats (e.g., nuclear annihilation), suggesting that the *type* of harshness is also significant.

Batres & Perrett (2014) found that harsh environments are also associated with increased preferences for facial cues to weight (i.e., adiposity). Research has found that people can accurately estimate a person's weight based on their face alone (Coetzee et al. 2009), that there is a strong relationship between body mass and perceived facial adiposity (Coetzee et al. 2009; Tinlin et al. 2013), and that facial adiposity is a better cue to health than BMI (Henderson et al. 2016). In El Salvador, Batres & Perrett (2014) found that men and women living in harsher environments (e.g., no access to running water) preferred female faces with higher levels of adiposity.

Preferences for cues to higher weights in bodies (Tovée et al. 2006) and faces (Batres & Perrett 2014) could be adaptive since heavier people may be better equipped to survive illnesses or uncertain food availability (Brown & Konner 1987). Even hunger level has been found to influence preferences, with hungrier men preferring heavier female figures than satiated men (Swami & Toveée 2006). These studies (Swami & Tovée 2006; Batres & Perrett 2014; Tovée et al. 2006) suggest that preferences change according to the individual's environment, but they do not track the same participants across environmental changes and therefore such a link cannot be confirmed.

Another preference that has been suggested to change depending on the environment is that for sexual dimorphism (i.e., the differences between males and females, commonly referred to as masculinity and femininity). In harsh environments, men have been reported to prefer more masculine female faces and women to prefer more feminine male faces (Batres & Perrett 2014; Marcinkowska et al. 2014; although results vary across studies, see Scott et al. 2014). Additionally, many priming experiments have found that simply exposing participants to harsh scenarios alters masculinity preferences (Little et al. 2007). For example, one study found that when exposed to a high environmental harshness scenario (e.g., "you live in a neighborhood that is dirty… dangerous… your neighbors are generally unfriendly… are faced with unemployment yet again… you owe back rent"), women preferred more feminine male faces and men preferred more masculine female faces as potential long-term partners (Little et al. 2007).

These studies (Tovée et al. 2006; Batres & Perrett 2014; Marcinkowska et al. 2014; Little et al. 2007) suggest that facial preferences may be contingent on an individual's environment. No study, however, has traced how the face preferences of the same individuals change as their environment changes. We therefore aimed to examine if, and to what extent, face preferences are malleable by repeatedly testing university students undergoing intensive training at an army camp. Based on previous research (Tovée et al. 2006; Batres & Perrett 2014; Marcinkowska et al. 2014; Little et al. 2007), we predicted that as these participants underwent their training, they would prefer heavier female faces as well as more feminine male faces and more masculine female faces. We also repeatedly tested a control group of university students whose environment was not changing.

2. Methods

2.1. Stimuli

Face images of 47 Caucasian men and 83 Caucasian women photographed facing forward, under constant camera and lighting conditions, with neutral expressions, no adornments, and closed mouths were selected from a commercially available library (3D.SK 2014), which also provided the age and body mass index of the individuals. These images were delineated with 189 points using custom software (Tiddeman et al. 2001) and aligned to a standard inter-pupillary distance (Rowland & Perrett 1995). Ten composite images (five male and five female) were created (each averaging three original faces together) and masked to occlude clothes with a black oval around the head (for details see Batres et al. 2015).

Male adiposity prototypes were generated by separately averaging 10 male faces with a low body mass index (Mean BMI=22.19 kg/m², SD=2.52; Mean age=25.10 years, SD=3.96) and 10 male faces with a high body mass index (Mean BMI=26.47 kg/m², SD=3.27; Mean age=24.80 years, SD=3.77). Female adiposity prototypes were generated by separately averaging 10 female faces with a low body mass index (Mean BMI=17.85 kg/m², SD=0.80; Mean age=22.70 years, SD=3.56) and 10 females faces with a high body mass index (Mean BMI=24.06 kg/m², SD=6.34; Mean age=23.40 years, SD=4.50). The masculinity prototypes were generated by separately averaging all of the female faces (Mean age=23.04 years, SD=3.81) and all of the male faces (Mean age=25.25 years, SD=4.64). The composites were then transformed to create 20-step continua using ±100% of the shape difference between prototypes while holding texture and color constant. This resulted in a total of 20 face continua (10 male and 10 female). Of the male and female continua, five reflected changes in adiposity (12.60 kg/m² to 25.04 kg/m² for female faces and 18.60 kg/m² to 27.15 kg/m² for male faces) and five reflected changes in masculinity/femininity (see Figure 1).

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152 2.2. Participants and Procedures

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154 Ethical approval was received from the University of St Andrews Ethics Board and all
155 participants provided consent. All participants completed the experiment three separate times
156 with time intervals of approximately three days between each testing session. The
157 experimental condition was conducted at a military base where university students (cadets in
158 the University Officer Training Corps) were attending a 10-day training camp. Session 1 was
159 conducted on the first day of the camp before the training commenced and Sessions 2 and 3
160 were conducted at approximately three-day intervals during the remainder of the training
161 camp. Twenty-three men (Mean age=19.48 years, SD=1.38) and eight women (Mean
162 age=19.25 years, SD=1.04) completed all three sessions of the training camp condition. The
163 control condition was conducted with students at the University of St Andrews with sessions
164 taking place with intervals of approximately three days. Nine men (Mean age=26.89 years,
165 SD=7.17) and 11 women (Mean age=22.45 years, SD=0.82) completed all three sessions of
166 the control condition.

167 Participants were presented with the 20 facial continua in male and female blocks,
168 with one continuum appearing at a time. Participants were instructed to change each face by
169 scrolling the computer cursor across the image (which transformed the face in either
170 adiposity or masculinity) and to click when they considered the face to be at its most
171 attractive. The scroll direction to increase the trait of interest (i.e., adiposity or masculinity)
172 was randomized across trials.

173 A questionnaire was then presented to participants in which they had to answer
174 questions intended to measure changes in their environment (on a scale from 1 “not at all” to
175 10 “very much”): “Currently, how tired are you?”; “Currently, how hungry are you?”;

"Currently, how stressed are you?"; "How much physical strain have you been under in the past three days?"; "How much mental pressure have you been under in the past three days?"; "How much pain are you currently in?"; "How much out of your comfort zone have you felt in the past three days?"; "How much have you been shouted at in the past three days?".

3. Results

3.1. Questionnaire

Independent samples t-tests for each question at each testing session revealed that there were no significant sex differences except for the second session in the control condition on the question of hunger. For all subsequent questionnaire analyses, data from men and women were aggregated. We then analyzed the training camp and the control conditions with repeated-measures ANOVAs where time (i.e., first, second, and third testing sessions) was the within-subjects variable. Greenhouse-Geisser corrections were used when the assumption of sphericity was violated.

The scores across the three testing sessions for the questions on tiredness and hunger were not significantly different in the control condition nor in the training camp condition across time (see Table 1). The scores for the questions on stress, physical strain, mental pressure, pain, comfort zone, and being shouted at were not significantly different in the control condition across time but they were significantly different in the training camp condition across time (see Table 1). Training camp participants reported higher levels of stress, physical strain, mental pressure, pain, being more out of their comfort zone, and being shouted at more after the first testing session.

3.2. Facial Preferences

Preferences were calculated as the mean level of adiposity and masculinity selected across the facial continua of each trait for each sex of face. Independent samples t-tests for preferences at each testing session revealed that there were significant sex differences for adiposity preferences in female faces (with males preferring lower levels of adiposity than females; $t(49)=-2.56$, $p<0.05$) and for masculinity preferences in male faces (with males preferring lower levels of masculinity than females; $t(49)=-2.17$, $p<0.05$). Consequently, we analyzed the data from men and women separately. Greenhouse-Geisser corrections were used when the assumption of sphericity was violated.

Independent samples t-tests for each preference at baseline (i.e., Session 1) revealed that there was a significant difference for the masculinity preferences in male faces between the female participants in the training camp and the female participants in the control condition ($t(17)=-2.76$, $p<0.05$). Female participants in the training camp preferred more feminine male faces than those in the control condition. There was also a trend for male participants in the training camp to prefer more feminine male faces ($t(30)=-1.73$, $p=0.095$).

We then analyzed the data using MANOVAs where changes in preferences (i.e., changes were computed as the mean level between Session 2 and Session 3 minus the level at Session 1) for the four face preference measures (i.e., female adiposity, male adiposity, female masculinity, male masculinity) were the dependent variables and condition (i.e., training camp or control) was the between-subjects factor. There was only a significant effect of condition for male participants looking at female adiposity faces ($F(1,30)=10.13$, $p<0.01$).

To ascertain when preference changes occurred, we further analyzed the data using repeated-measures ANOVAs where time (i.e., first, second, and third testing sessions) was the within-subjects variable with the four face preference measures (i.e., female adiposity,

male adiposity, female masculinity, male masculinity) as dependent variables and condition (i.e., training camp or control) was the between-subjects factor. There was a significant effect of time for male participants looking at female adiposity faces ($F(2,60)=5.27$, $p<0.01$) and for female participants looking at male adiposity faces ($F(2,34)=6.39$, $p<0.01$). There was only a significant interaction between time and condition for male participants looking at female adiposity faces ($F(2,60)=4.20$, $p<0.05$), with the male participants in the training camp (but not in the control condition) increasing their adiposity preferences in female faces. For the significant interaction between time and condition of male participants looking at female adiposity faces (see Figure 2), post-hoc tests were conducted. Preferences significantly increased between Session 1 and Sessions 2 and 3 ($p<0.05$ for each comparison) but were unchanged between Session 2 and Session 3 ($p=0.390$).

3.3. Questionnaire Results and Facial Preferences

Questionnaire responses were then used to explore whether changes in a particular stressor might underlie the significant interaction between time and condition for male participants looking at female adiposity faces. We analyzed the male participant data using an ANCOVA where the change in female adiposity preference (i.e., change was computed as the mean level between Session 2 and Session 3 minus the level at Session 1) was the dependent variable and the changes in tiredness, hunger, stress, physical strain, mental pressure, pain, being out of their comfort zone, and being shouted at were the covariates (i.e., changes were computed as the mean level between Session 2 and Session 3 minus the level at Session 1). There was no significant effect of any of the covariates on the female adiposity preferences of male participants ($p>0.103$ for all analyses; see Table 2).

4. Discussion

Our results show that there was a significant effect of time for male participants looking at female adiposity faces and for female participants looking at male adiposity faces. One possibility for this finding is that simply re-exposing participants to the same stimuli may influence adiposity preferences. One study found that simply exposing participants to a certain population of faces increases their preferences for similar faces (Cooper & Maurer 2008). Another study, however, found that experimentally manipulating the frequency of women's hair colour, which in European populations is highly polymorphic and thought to have evolved under frequency-dependent sexual selection, does not impact on preferences (Janif et al. 2015). Future research is therefore needed in order to understand why time had a significant effect for opposite-sex adiposity preferences.

Our questionnaire results show that the participants in the training camp condition, but not in the control condition, experienced an increase in the harshness of their environment as evidenced by their reports of higher stress, physical strain, mental pressure, pain, feeling out of their comfort zone, and being shouted at more during the training camp than in their 'normal' life at baseline. The only significant interaction between time and condition was that for male participants looking at adiposity in female faces. More specifically, the male cadets shifted their preferences from underweight women to slightly heavier (but still not overweight) women as the training camp progressed. This suggests that the increased level of harshness in the training camp increased the male cadets' preferences for adiposity in female faces. Past research has found that hunger level influences weight preferences, with hungrier men preferring heavier female figures than satiated men (Swami & Toveée 2006). In our study, however, hunger was not reported to be significantly different in the training camp,

suggesting that the observed changes in adiposity preferences are not being driven by hunger level.

Adiposity preferences for male participants looking at female faces increased between the first day of the camp before the training commenced (Session 1) and day three of training (Session 2) and then plateaued for the remainder of the training camp (Session 3). This suggests that the adiposity preferences of the male participants changed in response to the harsher environment and then remained at the new level while the environment remained harsh. It is interesting to note that the increased harshness of the training camp was enough to elicit a change in the male participants' preferences for female adiposity. This environmental harshness change is minor when compared to real-world changes in the environment (e.g., poverty), which may therefore produce even stronger changes in preferences. Additionally, the change in preferences manifested itself for the duration of the training camp, suggesting that preferences shift rather quickly. Female participants showed no change in adiposity preferences for men depending on condition, although some, but not all cross-cultural studies, have reported changes in women's preferences depending on their environment (Batres & Perrett 2014; Swami & Tovée 2005). Studies with larger sample sizes than that here may reveal malleable adiposity preferences in women who face changed harshness in environment.

One possibility for there only being a significant interaction for male participants looking at adiposity in female faces is that low weight, compared to normal weight, has been found to impair reproductive health in women (Brown et al. 2000; Grodstein et al. 1994), but the effects of low weight are less so in men (Sallmén et al. 2006). For instance, a minimum level of weight is necessary for ovulation and menstrual cycles (Frisch & McArthur 1974) and therefore, underweight women are less likely to conceive (Zaadstra et al. 1993). If they are able to conceive, underweight women are more likely to miscarry (Brown et al. 2000).

And, if they reach delivery, underweight women are more likely to have infants with low birthweights, whom are prone to suffer from long-term health problems (Van der Spuy et al. 1988). This suggests that malleability in adiposity preferences may confer stronger evolutionary benefits for men. Moreover, a harsher environment may heighten a man's desire to reproduce and hence change their preferences to a partner who is successfully able to do so.

When examining our questionnaire results alongside our facial preference results, we did not find a specific stressor that could explain the male cadets' changes in female adiposity preferences. This suggests that further studies are needed in order to understand which variables are responsible for the changes in preferences. For instance, the psychological state of the trainees might be influencing preferences. Preferences may shift towards somewhat heavier-looking female faces following training for social reasons. One study found that men and women were rated as more ethical (i.e., trustworthy and credible) as their weight increased (van Vugt et al. 2009). The additive effects of stress over time in the training camp may thus drive preferences towards more trustworthy individuals.

An emphasis on trustworthiness might also explain why participants in the training camp preferred more feminine male faces at baseline (Session 1) when compared to participants in the control condition. Even before the training commenced, participants in the training camp may be in a psychological state that predisposes them to prefer more trustworthy individuals. Or alternatively, individuals who join the army may, in general, prefer more trustworthy individuals. Research has found that increasing facial masculinity results in decreasing perceptions of warmth, cooperation, emotionality, and honesty (Perrett et al. 1998). These negative associations with masculinity may explain why in a training camp environment (or in the army in general), participants would prefer more feminine faces. It remains unclear, however, why we only found this effect for male, but not female, faces.

Future research is thus needed to examine the psychological differences between participants entering a harsh environment and those remaining in their normal environment.

Future research would also benefit from exploring the malleability of adiposity preferences using body silhouettes varying in body mass index and/or waist-to-hip ratio. Although people can accurately estimate a person's weight based on their face alone (Coetzee et al. 2009), facial cues to adiposity and strength (related to bones and muscles) overlap (Coetzee et al. 2010; Holzleitner & Perrett 2016), and strength can be more strongly preferred in partners when environments are harsh (Pettijohn & Tesser 1999; Pettijohn & Jungeberg 2004). Recent research has also found that the waistline is under strong evolutionary selection pressures since over the course of an eight-generation evolutionary selection design, it was the strongest target of selection (Brooks et al. 2015). Additionally, adipose tissue beyond the face is much more abundant, variable, easier to perceive in social contexts, and is associated with health (Singh & Singh 2011, World Health Organization 2011) so it would be interesting to also examine changes in adiposity preferences using full body stimuli.

5. Conclusions

Several studies (Batres & Perrett 2014; Tovée et al. 2006) have found that preferences differ between environments, yet to our knowledge, this is the first study to test the same individuals while their environment is changing. Our study supports the case for the malleability of preferences depending on the environment since we found that, during the training camp, participants reported increases in multiple stressors as well as showed changes in facial preferences. More specifically, we found that increases in the harshness of the environment were accompanied by an attraction to facial cues of increased weight in male participants looking at female faces. These changes may be adaptive because they allow for

increased opportunities to mate with partners who are better equipped to survive illnesses or uncertain food availability as well as to reproduce. Our sample size was sufficient to establish these changes in men's female adiposity preferences, yet it will require more extensive samples and more specific environmental challenges to distinguish which variables (e.g., psychological state) are responsible for such changes.

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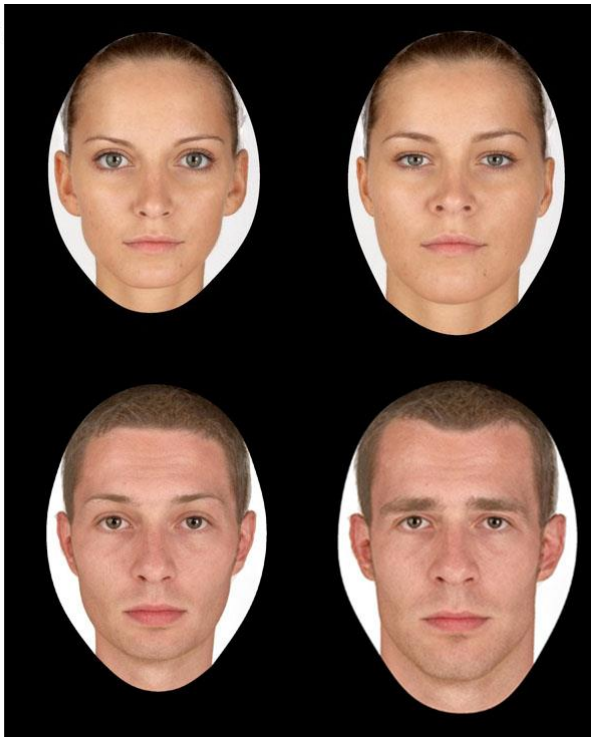
Table 1. Summary of repeated-measures ANOVAs for the questionnaire.

	Control Condition			*Training Camp Condition*		
	df	F	Sig	df	F	Sig
Tiredness	2,38	0.843	0.438	2,56	3.010	0.057
Hunger	1.5,28.1	0.815	0.419	2,56	1.831	0.170
Stress	2,36	2.609	0.087	1.6,46.7	3.658	0.042
Physical Strain	2,36	0.429	0.655	2,60	19.034	<0.001
Mental Pressure	2,34	0.169	0.845	2,60	50.763	<0.001
Pain	2,36	0.188	0.830	2,60	13.267	<0.001
Comfort Zone	2,36	1.379	0.265	2,56	12.848	<0.001
Being Shouted At	2,38	0.357	0.702	2,60	23.863	<0.001

Table 2. Summary of ANCOVA results for male participants looking at female adiposity faces.

	df	F	Sig
Change in Tiredness	1	0.693	0.415
Change in Hunger	1	2.939	0.103
Change in Stress	1	0.143	0.709
Change in Physical Strain	1	0.019	0.893
Change in Mental Pressure	1	0.316	0.581
Change in Pain	1	0.573	0.458
Change in Comfort Zone	1	0.365	0.553
Change in Being Shouted At	1	0.013	0.912
Error	19		

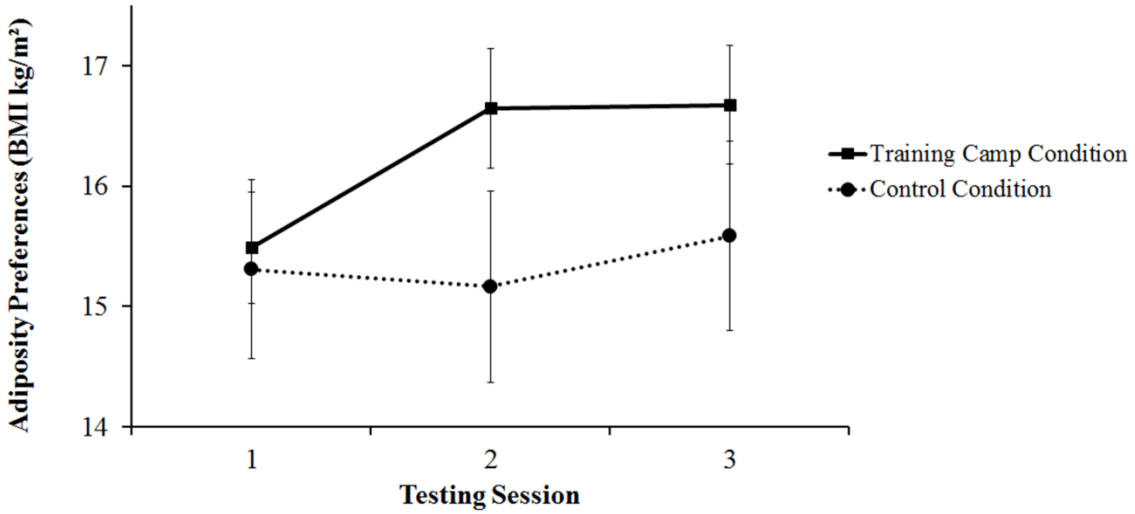
A)



B)

Figure 1. Visualization of the extreme images in 2 continua

One of the female composites (A), where the left face corresponds to a -100% adiposity transform and the right face corresponds to a +100% adiposity transform. One of the male composites (B), where the left face corresponds to a -100% masculinity transform and the right face corresponds to a +100% masculinity transform.



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572

573 Figure 2. Adiposity preferences for the male participants looking at female faces

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575 Comparison of adiposity preferences in female faces for the male participants across time in

576 the training camp and control conditions.