



## Seeing overweight adults as babies: Physical cues and implications for stigmatization

Anton J. M. Dijkers\*, Rutger DeLuster, Nicolas Peeters and Nanne K. de Vries

Faculty of Health, Medicine and Life Sciences, CAPHRI, Maastricht University, The Netherlands

Human babies not only are reliable triggers of tender feelings and protective tendencies, they also happen to be exceptionally fat compared to the newborns of most other species. These two facts are used to formulate a hypothesis predicting that overweight males, due to their great physical resemblance to babies, not only are perceived as cute, but also are associated with negatively evaluated traits (e.g., immaturity, lack of willpower) that are saliently inconsistent with traits required for adults. In this study, a great many physical features of adult males varying widely in weight were measured and correlated with subjective judgements. Providing preliminary support for the hypothesis, it was found that the features that were correlated with objective and perceived fatness (e.g., circularity of body parts, relatively large head, short and thick neck) also correlated with perceived babyishness. Perceived fatness and babyishness had curvilinear influences on the positive and prosocial appraisal of cuteness, but were primarily negatively related to perceived willpower and beauty. Results are used to formulate an alternative evolutionary perspective on social responses to overweight and obese individuals, emphasizing the uniquely human adaptive value of fatness and the misfiring of the underlying response mechanism under modern conditions of living.

Overweight and obesity are associated with elevated risks for diabetes, heart disease, and cancer, and are recognized as one of the major health problems currently facing the world's population (Friedman, 2009). It is increasingly recognized that stigmatizing reactions to overweight or obese individuals (for a review, see Puhl & Heuer, 2009) not only can demotivate these individuals to lose weight, but also induce stress responses that can promote overeating and fat deposition (Brewis, 2014; Major, Hunger, Bunyan, & Miller, 2014; Power & Schulkin, 2009). Hence, a thorough understanding of the nature and causes of stigmatization of overweight and obese people may contribute to attempts to fight obesity and promote healthy lifestyles.

This study argues that a systematic description of the physical and potentially visible features of adipose bodies, and of the motivational implications of these features, will improve both the psychological and evolutionary explanation of stigmatization of overweight and obese individuals. In addressing physical features of adipose bodies, we

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\*Correspondence should be addressed to Anton J. M. Dijkers, PO Box 616, 6200 MD Maastricht, The Netherlands (email: a.dijkers@maastrichtuniversity.nl).

assume that there is much more to be seen from these bodies than global and undesirable deviations in size, volume, weight, or body mass index or BMI (weight in kilograms divided by length in metres squared) from a particular standard. In particular, looking at overweight and obese individuals, one is normally exposed to variation in physical features such as skinfolds, flabbiness of fat tissue, curved forms, and skeletal muscles, as well as to body proportions that may be correlated with fatness such as relatively short and thick neck, relatively large head, apparently shorter legs, and a posture suggesting lack of balance; all aspects that, when not too extreme, could have both negative and positive emotional and motivational implications. That there is considerable room for positive appraisals is suggested by the frequently observed curvilinear relationships between judgements of attractiveness and BMI (Maisey, Vale, Cornelissen, & Tovée, 1999; Swami & Tovée, 2006; Tovée, Maisey, Emery, & Cornelissen, 1999) or facial adiposity (Coetzee, Perrett, & Stephen, 2009). The motivational relevance of different physical aspects could be overlooked, however, when only extremely obese exemplars are presented that appear severely deformed and handicapped due to their weight; schematic drawings, computer-generated avatars, or body contours are used as stimuli; or research participants are merely asked to attribute different traits to the labels *overweight* or *obese*. This study, therefore, used a large set of photographs of nude normal, overweight, and obese males, taking a wide variety of anthropometric measures from these pictures, and asking participants to attribute different traits to them, keeping an eye on curvilinear relationships between physical features and attributions.

In the rest of this introduction, we explain how detailed attention to the physical features of adipose bodies may contribute to both psychological and evolutionary explanations of stigmatization of overweight and obese persons. We will also hypothesize that physical features responsible for the perception of babyishness of adipose bodies play an important role in stigmatization.

### **Psychological explanation**

The proximate or psychological explanation of stigmatization of overweight and obese individuals has to account for the peculiar fact that, while severely discriminated in modern Western society (for a review, see Puhl & Heuer, 2009), these individuals are mentally represented in such a way that they do not arouse intense negative emotions, and even are associated with certain socially agreeable traits. In particular, after reviewing a large number of studies trying to derive dimensions or main concepts underlying the perception of, and emotional responses to, socially deviant or undesirable conditions, Dijker and Koomen (2007) concluded that overweight and obesity in Western societies are perceived as more similar to conditions associated with illness, disability, vulnerability, and dependency than to fear-arousing conditions such as mental, lethal, or contagious diseases, or anger-arousing conditions associated with intentional criminal behaviour. Consequently, overweight and obesity arouse moderate levels of sympathy or pity. Yet, what is distinctive about the category of conditions to which overweight or obese persons tend to be assigned (and which includes unemployment, poverty, being on welfare, low socio-economic status, and illnesses associated with high levels of personal responsibility) is that they arouse more irritation than the sick and handicapped, albeit to a lesser extent than individuals perceived as criminals (Dijker & Koomen, 2003, 2007; Weiner, Perry, & Magnusson, 1988). Furthermore, compared to active and relatively threatening deviant conditions, they arouse little fear.

Responsible for this distinctive representation seems to be the perception that particular group members are vulnerable and need support and help (thereby triggering prosocial tendencies in perceivers), yet show too little motivation to get out of their dependent and deviant condition. In other words, one is dealing here with group members that are perceived to misuse others' prosocial tendencies and engage in social parasitism. The mental representation of this category of deviant conditions does not refer to a problem of lacking competence, as some researchers (e.g., Fiske, Cuddy, Glick, & Xu, 2002) have suggested, neither of criminal or predatory forms of parasitism or cheating (although these conditions may be occasionally framed as such), but to a problem of lacking motivation (Brickman *et al.*, 1982), offset responsibility (Dijker & Koomen, 2003; Weiner *et al.*, 1988), violations of the 'sick role' (Parsons, 1951), or adults having immature or childlike attributes (LeVine & Campbell, 1972). Accordingly, the attitude towards the overweight and obese can be best characterized as one of 'not taking others seriously', frequently combined with both benevolent and malevolent forms of humour and laughter (Burmeister & Carels, 2014; Chou, Prestin, & Kunath, 2014; Yoo & Kim, 2012). A particular negative emotion – disgust – may be additionally aroused (Lieberman, Tybur, & Latner, 2012; Park, Schaller, & Crandall, 2007; Vartanian, 2010), yet it does not seem to be distinctively associated with overweight and obese individuals; politicians are rated as equally disgusting (Vartanian, 2010), suggesting that moral disgust may also be involved (Lee, Brooks, Potter, & Zietsch, 2015; Lieberman *et al.*, 2012). Speculatively, lack of impulse control may also be responsible for disgust arousal as it may be associated with perceived lack of self-care and hygiene.

Existing theoretical perspectives may not adequately account for this attitude and its associated mental representation. For example, it has been argued that adiposity in general is seen as abnormal or that it resembles certain swellings typical for infectious diseases, in both cases activating a mechanism motivating avoidance (Lieberman *et al.*, 2012; Park *et al.*, 2007). However, although extreme forms of obesity may certainly appear pathological, from an evolutionary perspective it seems unlikely that the presence of subcutaneous fat, a crucial marker of health and fitness, is confused with contagious illnesses and as something to be avoided. Indeed, in contrast to contagious illnesses such as AIDS, tuberculosis, or the flu, overweight and obesity arouse almost no fear (Dijker & Koomen, 2007). Furthermore and as noted earlier, although very adipose bodies tend to be considered unattractive in Western societies, the relationship between BMI and attractiveness is curvilinear, with the optimum of the distribution until recently located at relatively high BMI values in non-Western societies (Brewis, Wutich, Falletta-Cowden, & Rodriguez-Soto, 2011), thus leaving considerable room for positive appraisals of fatness. The optimum also shifts to higher BMI values when people experience lack of resources (Swami & Tovée, 2006).

The most influential theoretical explanation of stigmatization of overweight and obese individuals, however, is not concerned with the physical appearance of fat bodies but with people's causal explanation for an increase in volume or weight *per se*. The main conclusion drawn from this research is that stigmatization is caused by attributing increased fatness to behaviour (eating, lack of activity) that is under personal control, resulting in perceptions of laziness and weakness of character, together with responses of anger, blame, and social rejection (e.g., Crandall, 1994; Dijker & Koomen, 2003; Puhl & Heuer, 2009; Weiner *et al.*, 1988).

Although perceptions of low self-control and especially lack of motivation and willpower seem crucial elements of the Western image of the overweight and obese, they cannot sufficiently explain stigmatization. In particular, why should people become annoyed at perfect strangers who do not want to improve their condition? Why not let them

suffer or at least ignore them? Why should people care? Why is the emotional response relatively mild and non-aggressive? And why are adipose individuals, compared to predominantly muscular individuals and individuals lacking in both muscles and fat, associated not only with the highest percentage of negative traits, but also with the highest percentage of traits such as agreeableness, kindness, and humour (Butler, Ryckman, Thornton, & Bouchard, 1993)?

We believe that an important reason for the peculiar nature of the Western image of, and attitude towards, overweight and obese individuals is that these individuals physically resemble babies, thereby unconditionally triggering the same care mechanism and associated prosocial tendencies as babies tend to do (Lorenz, 1943). Yet, these protective tendencies and the associated perception of babyishness normally are inconsistent with physical, behavioural, and situational features indicating that one is not dealing with babies or infants but mature individuals. While babyishness may cause a positive appraisal (cuteness; see Alley, 1983; Glocker *et al.*, 2009) and feeling (tenderness; see Dijkers, 2014; Lishner, Batson, & Huss, 2011; Sherman & Haidt, 2011), it may be negatively evaluated in the light of traits that are required for adults such as responsibility for one's own health and motivation and capacity to contribute to society; resulting in perceptions of laziness and free riding. These negative evaluations may be especially likely in modern Western and individualistic societies where the negative health consequences of obesity are widely known and self-control and personal responsibility are highly valued (Crandall *et al.*, 2001). Complementarily, physical baby features may be used as evidence for the validity of culturally transmitted stereotypes that describe overweight and obese individuals as immature and lacking in self-control.

We believe it is worthwhile to start investigating whether perceived babyishness and traits typically attributed to overweight and obese individuals are correlated with different anthropometric measures. We first explain how our hypothesized care mechanism may also contribute to an evolutionary explanation for responding to fatness.

### **Evolutionary explanation**

Evolutionary explanations of stigmatization of socially deviant conditions tend to emphasize that certain physical, mental, or behavioural deviations from a particular standard are considered undesirable because they would signal a threat to fitness. Accordingly, psychological mechanisms would have evolved to deal effectively with these conditions. For example, it has been argued that responding to deviance involves the recognition and aggressive punishment of genetically unrelated non-cooperators or cheaters, the early detection and avoidance of contagious parasites, or dealing with the threatening and exploitative aspects of outgroups (Kurzban & Leary, 2001; Park *et al.*, 2007). Furthermore, when it comes to partner selection, individuals would be especially attentive to cues indicating good health and fitness (Grammar, Fink, Moller, & Manning, 2005).

However, in trying to derive the psychological mechanisms that would have evolved to respond adaptively to deviant conditions, theorists have insufficiently examined to what extent the deviant conditions with which early humans would have been faced, are species-specific, and hence would require uniquely human psychological adaptations to deal with. In particular, almost all socially living species need to recognize and respond effectively to cheaters, genetically unfit mates, contagious illnesses, or hostile outgroups, probably with the aid of very old and universal motivational systems responsible for threat detection, aggression, or disgust (Dijkers & Koomen, 2007). Humans, however, may have evolved unique psychological mechanisms for responding in more balanced rather than

primarily aggressive or stigmatizing ways to deviance, mechanisms which are more in line with both the genetic cost-benefit model of kin selection (Hamilton, 1964) and uniquely human physical and social traits (Dijker, 2011). As explained next, one such trait may be the permanent presence of, and exposure to, babies and infants in human hunter-gatherer societies.

### ***Fat babies, females, and males in evolutionary perspective***

Probably recognized by most biologists and anthropologists trying to characterize uniquely human traits are the altricial nature of human babies and their comparatively long dependency on monogamous parents and other adult group members (Hrdy, 2009). It is hypothesized that this uniquely human feature is responsible for the growth and development of the relatively big human brain, intelligence, and culture. An important social consequence of this long-term immaturity and dependency is that the whole social group should behave as a so-called cooperative breeding system, with unrelated adolescents and adults ready to take over nurturing and protective roles or at least showing high levels of social tolerance for playing, curious, hedonistically oriented and potentially annoying young group members (Hrdy, 2009). Noteworthy, many social and moral responses suggest a generalized application of a mechanism specifically devoted to infant-caregiver interaction, such as aggression inhibition in response to adults begging for forgiveness in an infantile manner, moral indignation and guilt when children as well as needy adults are victimized, or humour, play, and laughter as instruments of tolerance during social encounters (Dijker, 2014; Eibl-Eibesfeldt, 1989).

Which physical features of babies and infants are responsible for the triggering of a care mechanism? First consider their characteristic body proportions. Apart from being relatively small, the head of the newborn makes up 25% of the standing height, whereas the head of the adult is about half that proportion (Lowrey, 1973). Furthermore, the baby's legs are relatively short, making up about 35% of the standing height, whereas in the adult body, they make up about 47% (relative arm length does not differ between babies and adults). Also, the baby's neck clearly appears thick, short, and almost absent, and gets longer and thinner with increasing maturation. Finally, specific facial features of babies and infants (e.g., relatively large forehead, large eyes, and small nose and chin) are known to be responsible for perceptions of cuteness and tender and protective feelings (Berry & McArthur, 1986; Kringelbach, Stark, Alexander, Bornstein, & Stein, 2016; Lorenz, 1943; Zebrowitz, Fellous, Mignault, & Andreoletti, 2003). Of special relevance for the present paper, when the same features are present in adult faces, they arouse similar perceptions and reactions, suggesting that the perception of facial babyishness and the underlying care mechanism may be overgeneralized and easily misfires (Zebrowitz *et al.*, 2003).

However, what is most relevant for present purposes is that with its 15% body fat, the human newborn is exceptionally and saliently fat compared to the newborns of many other mammalian species, of which most have less than 6% fat (Kuzawa, 1998). Of special interest, the newborns of great apes such as the Bonobo (our closest living ancestor) are reported to have almost no subcutaneous tissue and appear skinny and wrinkled compared to the plump and chubby human newborn (Kuzawa, 1998; Zihlman & Bolter, 2015). In humans, adiposity reaches a peak of about 25% by 6–9 months, and then begins a gradual decline (Kuzawa, 1998). This suggests that increased fat deposition in babies and infants represents a uniquely human adaptation in the primate line (Zihlman & Bolter, 2015). There now is strong consensus that this has to be explained in terms of the energy that fat can supply to the fast growing and exceptionally large human baby and infant brain



(Kuzawa, 1998), a hypothesis aptly referred to as ‘survival of the fattest’ by Cunnane and Crawford (2003).

Because fatness in human babies and infants may function as a salient cue to health and fitness, its perception (together with the perception of other characteristic physical and behavioural features) may cause perceivers, especially when endowed with a strong and easily activated care mechanism, to perceive babies and infants as cute, beautiful, and worth of protection. The strong preference for fat babies may help explain why modern parents tend to underestimate the weight of normal-weight children and do not see overweight as a health problem (Lundahl, Kidwell, & Nelson, 2014).

How would fatness in human adults have been perceived and evaluated in early human hunter-gatherer societies, and how does this relate to the way fatness in babies is perceived? The best guess we can make about the degree of body fatness of human adults under ancestral conditions of living is to look at the available data for extant hunter-gatherers. We then find that adult men are, and adult women are not, very different from a 6- to 9-month-old baby in terms of fat percentage. For example, entering the mean BMI-value of 20 for three African hunter-gatherer groups – the Hadza, Efe, and !Kung (reported by Leonard, 2012) – into the formula proposed by Deurenberg, Weststrate, and Seidell (1991), and selecting an age of 25 years, we find about 25% fat for females, and 14% for males.

However, the relatively high and similar percentage of fat in babies and adult females serves a very different function. In particular, in females, fat reserves that are convertible to foetal tissue and milk are crucial for reproductive capacity, and the visible presence of these reserves may function as a cue to fecundability and successful motherhood. This may explain why early humans seemed to have adored exceptionally fat females, as is suggested by the frequently found statues of very obese Venuses, some of them more than 35,000 years old (Mellars, 2009). It also explains why many non-industrialized societies show a preference for fat females (Brown, 1991) and several African societies even engage in the intentional fattening of girls (e.g., by isolating them and putting them on a diet of milk and porridge), sometimes resulting in a degree of fatness that would be typical for severe obesity (Popenoe, 2004). It should be noted, however, that both extreme fatness and thinness in women can be additionally explained in terms of competition or runaway selection (Etcoff, 1999); that is, if men see somewhat more fat as desirable, a little bit more fat will give a woman an advantage. The same may be true for extreme thinness in egalitarian Western societies where women increasingly occupy male jobs, and slimness may be seen as an emblem of social status (Etcoff, 1999).

Under ancestral conditions, fatness in males may have been far more exceptional, given regular food shortages and the particular male roles that would require muscularity, such as hunters, warriors, or defenders. Yet, in males, portliness would have been a salient cue for the availability of resources and power, perhaps more typically present in leaders and, in later historical periods, successful business men (Forth, 2013).

We believe that overweight males in modern society are more likely to trigger a care mechanism evolved to respond specifically to babies than overweight females. First, overweight males not only share physical indicators of fatness (e.g., fat bellies, chubby arms and legs, and a short and thick neck) with normal-weight babies; adult males and babies also resemble each other because both lack female breasts. Second, spontaneous comparisons between overweight females and babies seem less likely as the former are more likely to be judged with respect to successful caregiving or motherhood, or a slim beauty standard. More generally, in relatively egalitarian and peaceful modern democracies, a care mechanism seems strong and easily activated (Dijker & Koomen, 2007), thus increasing the chance that overweight and obese males are indeed confused with babies.

### **The present study**

Focusing on correlational rather than causal relationships between measured variables, the goal of this study was to examine several minimal requirements for the present hypothesis to be valid (more advanced tests are suggested in the Discussion section). In particular, the following more specific hypotheses were tested. First, there are many different and large physical similarities between adipose adults and babies. Second, these physical features are indeed perceived as babyish. Third, these features are positively correlated with a distinct positive appraisal with prosocial consequences: cuteness, a perception associated with tenderness and care. Fourth, perceived babyishness is negatively related to perceived willpower. As high levels of fatness may be negatively appraised as lazy or ugly, and hence may result in reduced appraisals of cuteness, we expected the relationship between cuteness and fatness or babyishness to be curvilinear. Finally, based on previous research (Frederick & Haselton, 2007; Maisey *et al.*, 1999), we expected that features associated with masculinity such as a large shoulder-to-hip ratio indicating a V-shaped body or muscularity would be positively associated with traits such as willpower and beauty.

## **Method**

### **Participants**

A total of 99 university students (mean age = 21 years,  $SD = 1.95$ ; mean BMI = 22.46,  $SD = 2.90$ ) participated in the study. The sample consisted of 23 men and 76 women. Participants voluntarily signed up for a study titled *Impressions of the human body* and received 7.5 euro for participation.

### **Stimulus materials**

As we were unable to find a large collection of relatively recently taken photographs of men posing in standard manner, we decided to rely on the *Atlas of men* (Sheldon, Dupertuis, & McDermott, 1954). With his somatotypology, Sheldon attempted to describe the human physique in terms of a combination of endomorphy (closely related to degree of fatness), mesomorphy (primarily associated with muscularity), and ectomorphy (indicating the absence of fat and 'linearity'). Although Sheldon's theorizing, method of classification, and measurements of the three components have been criticized and expanded (Carter & Heath, 1990), his collection of 1,175 examples of 88 different combinations of endo-, meso-, and ectomorphy, presented in the *Atlas of men*, should still be considered the most complete, publicly available source of visual information on variability of men's bodies. The men (most of college age) shown in the *Atlas* adopted a standard posture (with faces and genitals covered) and were photographed in a standard manner from a frontal, lateral, and dorsal view, resulting in whole-body photographs on which visible differences in body height correspond closely to actual differences in height. The photographs are accompanied with information about the particular somatotype, age, and height-to-weight ratio.

We used the following method to select from the *Atlas* as many photographs as possible for our study. Examining each page of the *Atlas*, on which the photographs of six different men were shown, only photographs of frontal views were selected that were of sufficient quality. Furthermore, the photographed men had to be Caucasian and of white skin colour (too few African American and Asian Americans were included in the collection to allow for meaningful comparisons between racial or ethnic groups) and between 17 and 40 years of age. Several men were excluded because of a deviant posture or an abnormal body mark.

This resulted in a selection of 313 photographs. After scanning the pictures and converting them to JPEG files (resolution of 300 dpi), 21 additional pictures that appeared of relatively poor quality were also removed, resulting in a final set of 292 stimulus photographs (Mean age = 23.23 years,  $SD = 5.23$ ). BMI of the men could be well predicted from the height-to-weight ratio or HWR (height in inches divided by the cube root of weight in pounds) reported by Sheldon *et al.* (1954), using the power function:  $BMI = 16221.43/HWR^{2.57}$  ( $R^2 = .99$ ; mean BMI = 24.28,  $SD = 5.10$ ). (Appendix A presents the numbers of the photographs selected from Sheldon *et al.*, 1954; and Appendix B shows the distribution of Sheldon's somatotypes among the males that we selected.)

### **Procedure**

We used the following procedure to ensure that each photograph could be judged on each of ten response scales by a sufficient number of participants, given a study duration of 1 hr for each participant. First, we divided the set of 292 photographs in four randomly selected subsets of 73 photographs and determined for each subset also a second random order, resulting in a total of eight subsets. Participants were randomly assigned to view one of these subsets and to judge the 73 photographs on five randomly selected response scales. In this way, each of the 292 photographs received ratings on each of the 10 response scales by minimally 11 and maximally 15 participants. (We estimated that a lower limit of 10 participants per photograph and per scale would be sufficient to compute reliable mean scores across participants; see below for reliabilities.)

To reduce the likelihood that the rating of a particular body on one scale would influence ratings of the same body on other scales, a subset of photographs was presented five times so that all ratings on one scale were completed before proceeding to another. The black and white photographs (with a height of 22 cm and width between 6 and 7 cm) were presented on the screen of a personal computer.

After explaining the voluntary nature of the study and giving general instructions, several sample pictures of men differing widely in fatness were shown, also introducing the particular response scale to be used. The presentation of the stimulus photographs then proceeded automatically after pressing the space bar. Each photograph was shown for 6 s, with a blank slide shown for 2 s between two photographs, allowing participants a total of 8 s to arrive at their judgements. After each series of 25 photographs, participants were allowed to rest for several minutes, after which they pressed the space bar to start the next series. After judging the last photograph of a subset of 73 photographs, the new response scale was explained, and the participants started the presentation again by pressing the space bar. Participants completed the study individually, seated in small cubicles.

### **Anthropometric and perceptual measures**

We used the software program ImageJ, an open-source and Java-based program for digital image analysis developed by the National Institutes of Health (Schneider, Rasband, & Eliceiri, 2012) to measure, in terms of number pixels, the length, perimeter, and surface of different body parts, using these variables subsequently to calculate different ratios and circularities. Appendix C shows where we placed the landmarks on the photographs and describes how the measurements were taken. Determining the appropriate location of the landmarks may be partly influenced by individual decisions, especially when fatness makes it difficult to find the right location. Furthermore, enclosing a particular area of the



body with the area selection tool in ImageJ is partly influenced by the particular way in which the cursor is moved to enclose a particular area. We therefore used two judges (who almost completed their masters in medicine) to independently take measurements of all 292 photographs. A third judge (an undergraduate in medicine) measuring a random sample of 48 photographs was used to establish with more precision the reliability of the measurements. As can be seen from Table 1, measurements taken with the aid of ImageJ proved to be very reliable (with the exception of measuring the perimeter of the upper leg). In addition, hairiness was also reliably assessed. We therefore averaged the scores of two judges, a and b, for each of the 292 photographs. Shoulder-to-shoulder length was only measured by one of these judges. Yet, as can be seen from Table 1, it showed high consistency with the third judge on the random sample of 48 photographs.

To determine the relevant bodily proportions, we computed from the length measures provided by ImageJ the following ratios. First, on the basis of body height or stature, we calculated the head-to-height, neck (height)-to-height, arm-to-height, and leg-to-height ratio. Furthermore, as an indicator of relative horizontality due to fatness we also computed a waist-to-height and hip-to-height ratio, with increasing values indicating a more squared than elongated body. Also, on the basis of shoulder-to-shoulder length, we calculated the neck (width)-to-shoulder and shoulder-to-hip ratio (high values of the latter indicate a V-shaped body typical for muscular males, whereas low values suggest an inverted V-shaped or 'pear-shaped' body of overweight adults). A final proportion that we calculated from the length measures was the frequently used waist-to-hip ratio or WHR.

ImageJ provides a measure of the circularity of objects, using the following formula:  $\text{circularity} = 4\pi \times (\text{Area}/\text{Perimeter}^2)$ , with a value of 1 indicating a perfect circle, and values approaching 0 indicating an increasingly elongated shape. (Circularity is inversely

**Table 1.** Interjudge agreement (Cronbach's alpha) for measured anthropometric features

Feature measured	Judges A and B (N = 292)	Judges A, B, and C (N = 48)
Body height	.98	1.00
Head length	.86	.93
Neck width	.78	.84
Neck height	.83	.89
Shoulder-to-shoulder <sup>a</sup>		.93
Arm length	.94	.97
Leg length	.90	.96
Waist width	.97	1.00
Hip width	.98	.99
Head perimeter	.91	.95
Trunk perimeter	.83	.93
Upper arm perimeter	.78	.79
Lower arm perimeter	.80	.83
Upper leg perimeter	.64	.78
Lower leg perimeter	.84	.90
Hairiness <sup>b</sup>	.87	

Note. Judges A and B measured all variables except one on 292 photographs. Judges A, B, and C measured all variables except one on a random sample of 48 photographs.

<sup>a</sup>Only judge A measured this variable on all 292 photographs.

<sup>b</sup>This variable was not measured by judge C.

related to the perimeter-to-area ratio, which has been shown to be highly correlated with BMI when calculated for the whole body; Tovée *et al.*, 1999.) We determined the circularity of the following body parts: trunk, upper and lower arm, upper and lower leg, and head.

The following 10 scales were used to obtain subjective judgements of the photographs: fatness (1 = *extremely thin*, 9 = *extremely chubby*), muscularity (1 = *absolutely no muscles*, 9 = *extremely muscular*), willpower (1 = *extremely lazy*, 9 = *extremely strong-willed*), beauty (1 = *extremely ugly*, 9 = *extremely beautiful*), reminds one of a baby or babyishness (1 = *does not resemble a baby at all*, 9 = *extremely resembles a baby*), cuteness (1 = *absolutely not cute*, 9 = *extremely cute*), friendliness (1 = *extremely unfriendly*, 9 = *extremely friendly*), maturity (1 = *extremely immature*, 9 = *extremely mature*), general feeling aroused by the person (1 = *extremely negative*, 9 = *extremely positive*), and estimated age in number of years. After rating the photographs, participants reported their gender, age, length, and weight.

Participants generally showed high inter-rater agreement in their ratings of the photographs, with mean Cronbach alpha's (based on the responses of 11–15 participants to the 73 photographs of the different subsets) of eight of the 10 response scales lying between .77 and .98. The mean alphas for judgements of Cuteness and Friendliness were .70, and .64, respectively (we decided to drop the latter variable from further analysis). As the ratings showed satisfactory consistency, mean scores were computed across participants for each of the 292 photographs.

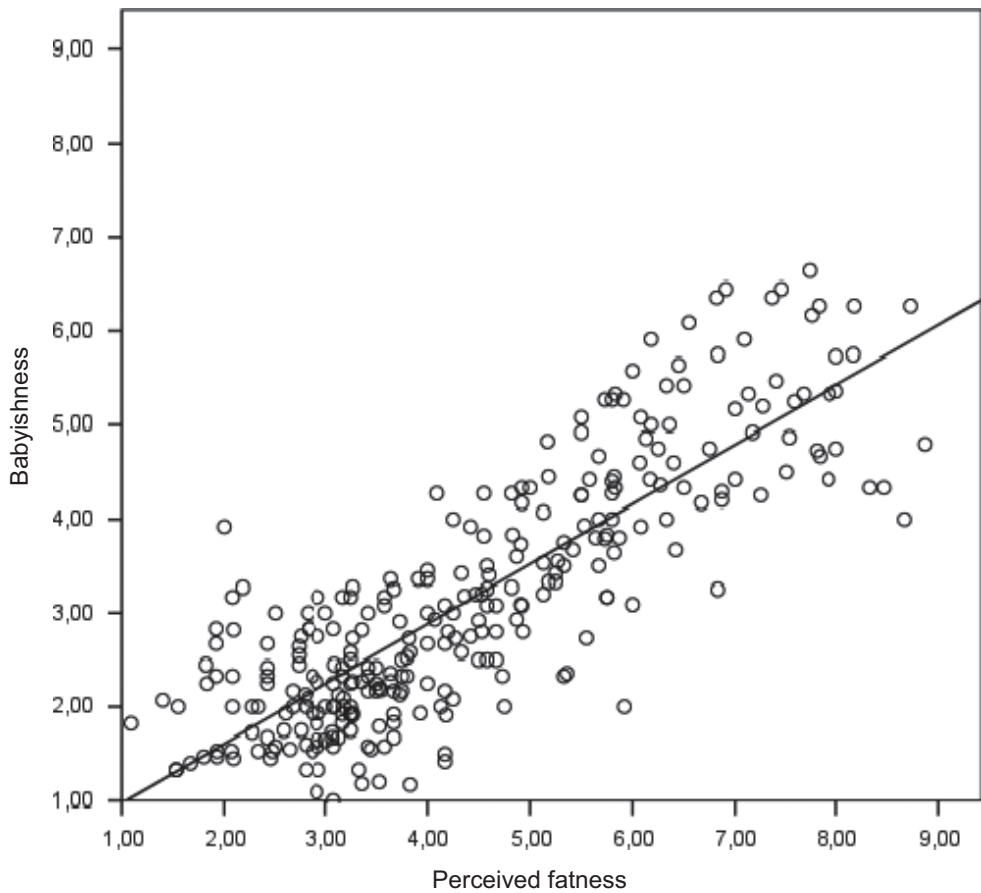
## Results

### **Are physical indicators of fatness associated with babyishness?**

Table 2 suggests that adult males that are objectively (as measured by BMI) and subjectively (as measured by perceived fatness) overweight or obese are associated with clear visible indicators of body fat, such as rounded trunk, head, and limbs (as evidenced by the circularities), as well as larger waist-to-height ratio and hip-to-height ratio, and smaller shoulder-to-hip ratio. Table 2 also shows that the measured bodily proportions that do not necessarily go together with fatness, yet are characteristic for babies, are also associated with objective and perceived fatness in adult males; that is, fatness in adults is associated with short stature, relatively large head, having short and thick necks (neck-to-height and neck-to-shoulder ratios themselves are negatively correlated,  $r = -.36$ ,  $p < .001$ , indicating that neck length and width are physically dependent and change in an opposite manner), and relatively short legs (but not short arms). It may thus be concluded that the total configuration or Gestalt of bodily features of adipose adult males shows a strong resemblance with the physical appearance of babies.

Our hypothesis implies that the physical cues that are typical for overweight and obese males and objectively similar to those of babies will also highly correlate with the subjective perception of babyishness. Table 2 confirms this hypothesis for almost all anthropometric measures taken. Furthermore, perceived overall fatness is strongly correlated with perceived babyishness,  $r = .84$ ,  $p < .001$  (see Figure 1). This relationship also holds when controlling for differences in perceived age, muscularity, hairiness, and beauty (partial  $r = .73$ ,  $p < .001$ ).

Also note that babyishness is more likely derived from the perception of physical cues than from judgements of age. In fact, most fatness cues are associated with higher



**Figure 1.** Relationship between perceived babyishness and fatness.  $\text{Babyishness} = 0.34 + 0.64 \text{ Fatness}$ ,  $R^2 = .70$ ,  $F(1, 290) = 681.43$ ,  $p < .001$ .

perceived age; the same is true for BMI ( $r = .40$ ,  $p < .001$ ). Furthermore, fatness cues are more weakly related to perceived immaturity than to babyishness.<sup>1</sup>

Table 2 also suggests that most measured physical features are negatively related to perceived muscularity, suggesting that greater fatness implies less visible muscles. Yet,

<sup>1</sup>The current data are not entirely suitable to determine the individual contributions of the measured physical features or proportions in explaining babyishness. First, if we want to use the proportions presented in Table 2 as predictors, we are faced with problems of multicollinearity as many proportions share the same denominator. Second, the extent to which the measured physical features covary is influenced by physical constraints. In particular, fat deposition may simultaneously affect all measures sharing a horizontal dimension (e.g., waist, neck width, areas occupied by the head, legs, and trunk), whereas differences in bone growth may affect different indicators of verticality (e.g., height, neck length, arm length, and leg length). Indeed, a factor analysis performed on all horizontal and vertical length measures resulted in two independent factors with eigenvalues  $> 1$ : horizontality (eigenvalue = 3.24, accounting for 36% of the variance) and verticality (eigenvalue = 3.00, accounting for 34% of the variance). Furthermore, as the measures of circularity may be related in complex ways to both horizontal and vertical aspects, we included these measures in a separate factor analysis, resulting in a single circularity factor with eigenvalue  $> 1$  (eigenvalue = 3.47, accounting for 58% of the variance). Regression analysis of perceived fatness on these three factors showed additive effects of horizontality ( $\beta = .58$ ,  $p < .001$ ), verticality ( $\beta = -.24$ ,  $p < .001$ ), and circularity ( $\beta = .29$ ,  $p < .001$ ),  $R^2 = .77$ ,  $p < .001$ . Regressing babyishness on the three factors also revealed additive effects of horizontality ( $\beta = .36$ ,  $p < .001$ ) and circularity ( $\beta = .31$ ,  $p < .001$ ) but no influence of verticality ( $\beta = -.14$ ,  $p = .10$ ),  $R^2 = .43$ ,  $p < .001$ . The relative influence of two global physical features – perceived fatness and muscularity – on different subjective ratings will be examined below. In the Discussion section, we suggest a more appropriate way to assess the relative influence of different physical features on perceived babyishness.

**Table 2.** Relationships between different anthropometric variables and perceived traits

Anthropometric variable	M	SD	Correlation with BMI and perceived traits									
			Height (in pixels)	Length ratios	BMI	Fatness	Babyishness	Maturity	Age	Muscularity	Cuteness	Cuteness <sup>a</sup> (polynomial)
Height (in pixels)	872	42	-.35	-.27	-.23	.15	-.03	-.02	-.37	.37	.09	.11
Length ratios												
Waist-to-height	0.17	0.02	.92	.89	.70	-.23	.46	-.45	-.13	.46	-.56	-.64
Hip-to-height	0.20	0.02	.87	.89	.73	-.34	.33	-.52	-.04	.44	-.60	-.70
Waist-to-hip	0.81	0.05	.45	.38	.24	.10	.39	-.05	-.17	.30	-.15	-.15
Head-to-height	0.14	0.01	.54	.51	.40	-.19	.12	-.20	.18	.20	-.29	-.33
Neck (height)-to-height	0.05	0.01	-.50	-.59	-.50	.31	-.17	.43	.07	.07	.43	.52
Neck (width)-to-shoulder	0.33	0.03	.48	.50	.45	-.29	.20	-.36	.03	.16	-.38	-.44
Arm-to-height	0.32	0.01	-.06	.04	.01	-.02	.00	-.11	-.08	.11	-.08	-.09
Leg-to-height	0.45	0.02	-.70	-.60	-.43	.10	-.30	.20	-.09	.28	.30	.35
Shoulder-to-hip	1.12	0.11	-.57	-.68	-.68	.53	-.17	.68	.02	.32	.64	.75
Circularities												
Trunk	0.68	0.03	.81	.83	.69	-.26	.43	-.47	-.10	.38	-.55	-.63
Upper arm	0.48	0.04	.40	.36	.21	.03	.11	.10	.18	.21	-.02	-.04
Lower arm	0.55	0.04	.68	.57	.42	-.03	.34	-.12	.06	.20	-.26	-.28
Upper leg	0.62	0.04	.77	.72	.56	-.16	.31	-.24	.12	.27	-.35	-.43
Lower leg	0.48	0.05	.78	.72	.58	-.22	.30	-.29	.10	.34	-.40	-.46
Head	0.91	0.02	.46	.46	.42	-.18	.15	-.24	.05	.14	-.29	-.34
Hairiness	1.03	0.99	.10	.04	-.13	.28	.32	.12	-.03	.08	.08	.11

Note. N = 292.  $|r| > .10, p < .05$ .

<sup>a</sup>Multiple correlations are shown for polynomial regression equation. Except for height ( $p < .05$ ), all significant  $R_s$  ( $|R| > .15, p < .05$ ) represent concave quadratic relationships.

only the shoulder-to-hip ratio (indicating a V-shaped body) and a relatively long neck are positively correlated with perceived muscularity.

### ***Has an overweight adult the same affective and prosocial consequences as a baby?***

It is important to demonstrate that babyishness is not simply a negative and derogatory synonym for immaturity and that it has the prosocial motivational implications that we intended to measure with the term *cuteness*. Observe from Table 3 that, although cuteness is associated with positive feelings (yet not as strongly as beauty, willpower, or muscularity), it seems unrelated to perceived overall fatness and babyishness. Furthermore, Table 2 suggests that cuteness is also unrelated to physical fatness and baby features. However, a different conclusion can be drawn when a curvilinear function is fitted to the data with a polynomial regression. Table 2 shows that, except for head size, neck length, and upper arm circularity, the quadratic associations with cuteness show a better fit than the linear ones, are significant, and indicate a concave or inverted U-shape. Furthermore, the scatterplot presented in Figure 2 reveals that perceived overall fatness influences cuteness in a curvilinear manner. The same is true for the influence of babyishness on cuteness:  $\text{Cuteness} = 2.46 + 1.17 \text{ Babyishness} - 0.17 \text{ Fatness}^2$ ,  $R^2 = .18$ ,  $F(2, 289) = 31.40$ ,  $p < .001$  (again, the linear expression is non-significant:  $\text{Cuteness} = 4.28 - 0.02 \text{ Babyishness}$ ,  $R^2 = .002$ ,  $F(1, 290) = 0.51$ ,  $p = .48$ ).

Yet, Figures 3 and 4 illustrate that perceived fatness also has negative affective consequences. In particular, note the strong curvilinear influence of fatness on beauty and willpower, with very fat bodies generally being associated with ugliness and laziness. Thus, although fatness is linearly related to perceived babyishness (Figure 1), high levels of fatness are strongly associated with negative traits.

### ***Is babyishness associated with perceived laziness?***

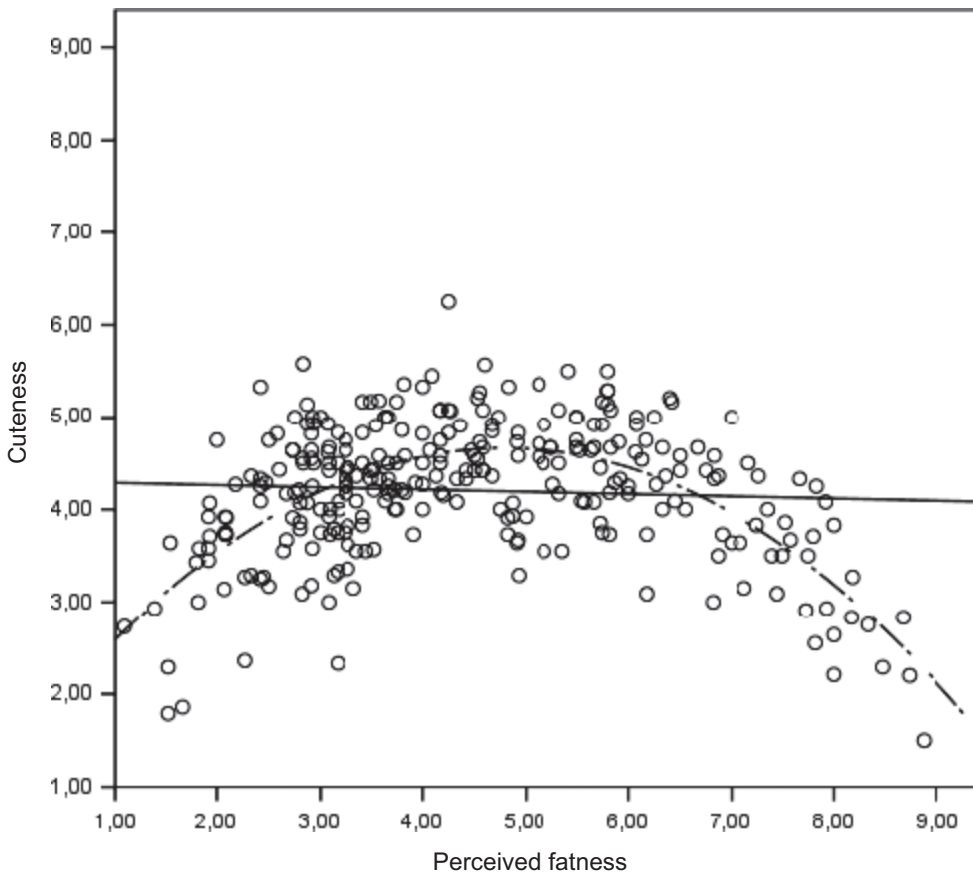
Consistent with our hypothesis, Table 3 shows that babyishness is strongly and negatively correlated with willpower, one of the two traits traditionally considered as central to the content of stereotypes about overweight and obese individuals. Note from the correlations in Table 3 that, in addition to perceived fatness, perceived muscularity has a strong positive influence on judgements of willpower and beauty, and even is positively associated with cuteness ratings.

**Table 3.** Means, standard deviations, and intercorrelations of the perceived traits

Perceived trait	M	SD	1	2	3	4	5	6	7	8
1 Fatness	4.43	1.75	–							
2 Muscularity	4.60	1.62	-.59	–						
3 Perceived age	28.92	3.71	.37	-.12	–					
4 Babyishness	3.15	1.33	.84	-.76	.16	–				
5 Maturity	5.37	0.91	-.35	.74	.19	-.63	–			
6 Cuteness	4.20	0.74	-.06	.27	-.21	-.04	.15	–		
7 Beauty	4.69	1.43	-.68	.92	-.22	-.79	.71	.35	–	
8 Willpower	5.17	1.34	-.75	.92	-.19	-.83	.72	.24	.90	–
9 Positive feelings	4.88	1.20	-.65	.91	-.18	-.78	.76	.31	.94	.91

Note.  $N = 292$ .  $|r| > .12$ ,  $p < .05$ .



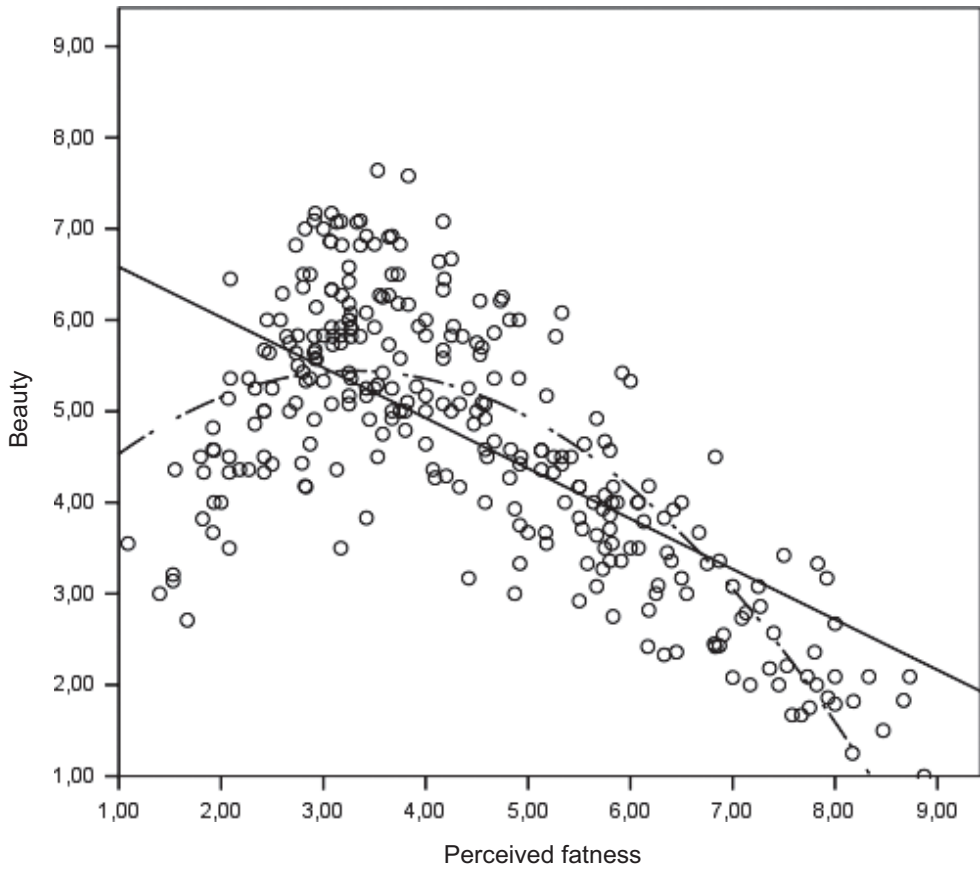


**Figure 2.** Relationship between perceived cuteness and fatness. Cuteness (linear) =  $4.31 - 0.02$  Fatness,  $R^2 = .003$ ,  $F(1, 290) = 0.94$ ,  $p = .33$ . Cuteness (quadratic) =  $1.35 + 1.38$  Fatness  $- 0.14$  Fatness<sup>2</sup>,  $R^2 = .41$ ,  $F(2, 289) = 99.65$ ,  $p < .001$ .

### **Alternative explanations**

The fact that high levels of fatness are strongly associated with negative traits (Figures 3 and 4) may partially explain why the former fail to arouse a positive appraisal such as cuteness, and a curvilinear relationship between fatness and cuteness was obtained (Figure 2). However, it could additionally be possible that the left half of the curve shown in Figure 2 is explained by the skinny ectomorphs arousing very little cuteness. In addition, the muscular mesomorphs to be found in the middle of the weight distribution rather than the overweight endomorphs may be associated with relatively high levels of cuteness. To examine these possibilities, we computed a path model exclusively for the normal and overweight individuals, using objective BMI values as a selection criterion (see Appendix B). An additional advantage of removing the extreme degrees of fatness is that the relationships studied are likely to be linear.

In the path model shown in Figure 5, fatness and muscularity have independent effects on babyishness and the other subjective ratings. Importantly, controlling for muscularity, fatness has only an indirect effect on cuteness that is mediated by babyishness. In particular, without babyishness included in the model, fatness and cuteness are related ( $\beta = .28$ ,  $p < .001$ ), whereas this relationship disappears after



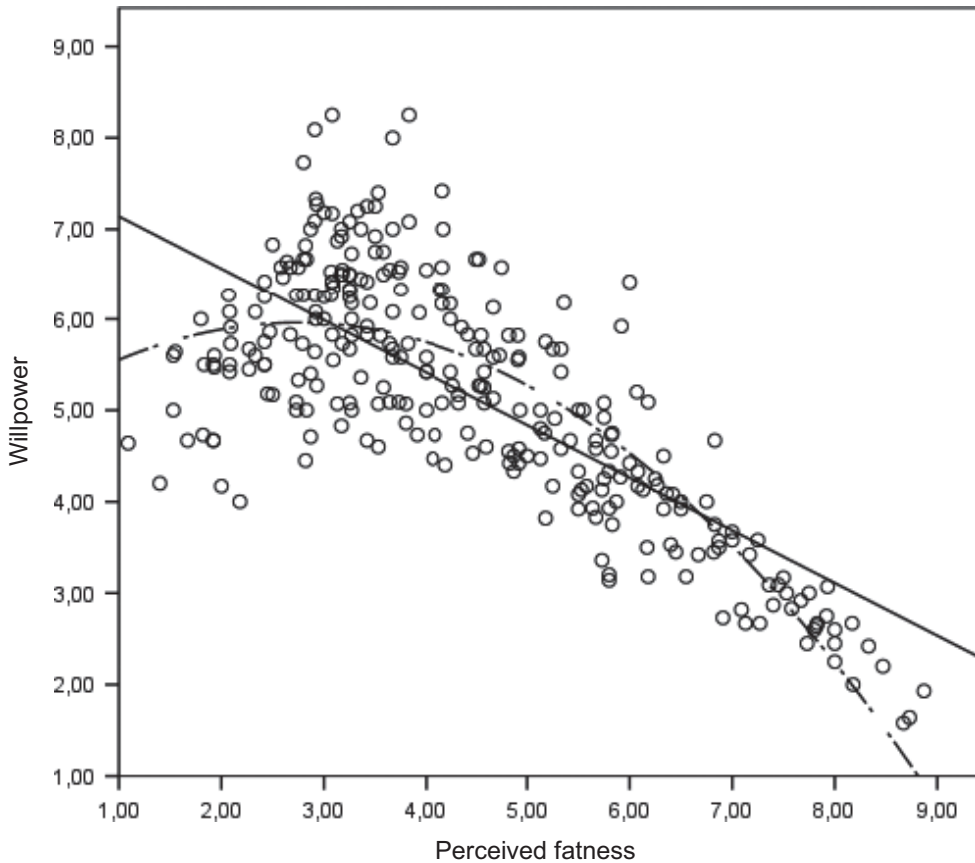
**Figure 3.** Relationship between perceived beauty and fatness. Beauty (linear) =  $7.14 - 0.55 \text{ Fatness}$ ,  $R^2 = .46$ ,  $F(1, 290) = 243.43$ ,  $p < .001$ . Beauty (quadratic) =  $3.56 + 1.14 \text{ Fatness} - 0.17 \text{ Fatness}^2$ ,  $R^2 = .62$ ,  $F(2, 289) = 230.45$ ,  $p < .001$ .

entering babyishness ( $\beta = .10$ ,  $p = .35$ ), with a significant Sobel test ( $Z = 2.31$ ,  $p < .05$ ) suggesting mediation. Also note that fatness has both direct and indirect effects on willpower (Sobel's  $Z = 3.46$ ,  $p < .001$ ) and beauty (Sobel's  $Z = 2.58$ ,  $p < .001$ ). Although all effects of muscularity on beauty, willpower, and cuteness are also mediated by babyishness (all Sobel's  $Z$ s  $> 2.29$ ,  $p$ s  $< .05$ ), it is clear from the path coefficients in Figure 5 that muscularity has a stronger direct influence on these variables which is independent from babyishness. Interestingly, muscular males probably are found cute for other reasons than babyishness, as babyishness decreases as muscularity increases.

In conclusion, the relationships between fatness, babyishness, and cuteness are not due to inclusion of the least cute or least beautiful skinny ectomorphs in the stimulus set. The relationships still hold for a more normal weight range, and after controlling for differences in muscularity.

## Discussion

This study found that the physical cues measured from photographs of adult males and expected to correlate with objective and perceived fatness also correlated with perceived

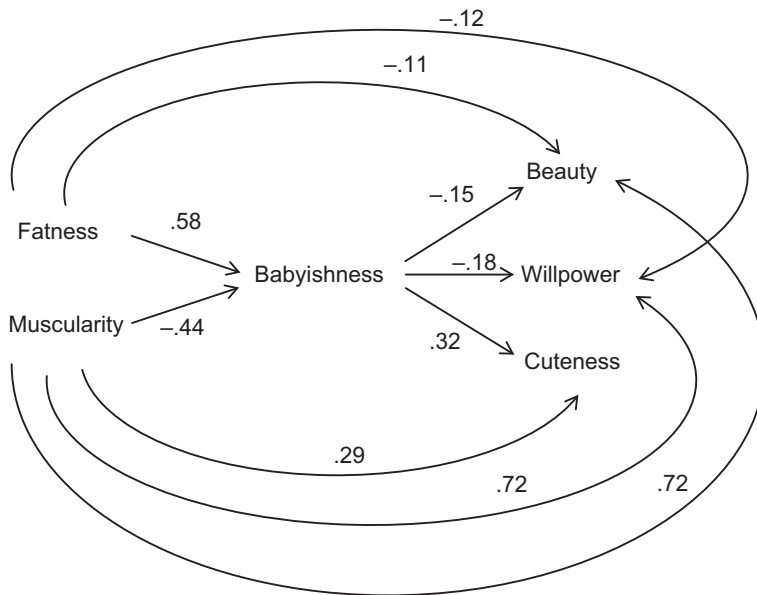


**Figure 4.** Relationship between perceived willpower and fatness. Willpower (linear) =  $7.72 - 0.58$  Fatness,  $R^2 = .57$ ,  $F(1, 290) = 379.50$ ,  $p < .001$ . Willpower (quadratic) =  $4.95 + 0.74$  Fatness  $- 0.14$  Fatness<sup>2</sup>,  $R^2 = .68$ ,  $F(2, 289) = 300.71$ ,  $p < .001$ .

babyishness. Importantly, this was true for almost all measured features, both features that can be considered typical for fatness and those not necessarily associated with fatness, yet typical for babies. It is not always clear to what extent particular baby features are objectively present or are caused by measurement problems. For example, an expanding abdomen and chubbier legs may make it more difficult to observe the point on the body where the legs start, resulting in apparently shorter legs of obese individuals.

Many physical baby features, as well as perceived overall fatness, appeared to have a curvilinear influence on cuteness, a distinct positive appraisal. Furthermore, the influence of perceived fatness was independent of perceived muscularity. Interestingly, perceivers were willing to associate higher levels of fatness with this positive appraisal than with judgements of beauty,<sup>2</sup> suggesting that an exclusive focus on beauty or attractiveness in past research may have obscured the potential desirability of adiposity. We also showed

<sup>2</sup>Calculating the maxima from the polynomial equations predicting beauty and willpower, we find that they correspond to fatness values of 3.35 and 2.69, respectively. However, the maximum of cuteness is located at a higher fatness value of 4.93, indicating that participants tolerated a higher level of fatness when responding to men with the highest level of cuteness.



**Figure 5.** Path model showing direct and indirect effects of fatness and muscularity on perceived beauty, willpower, and cuteness, as well as a mediational role for perceived babyishness. The model is computed for a subsample of normal and overweight males ( $18.6 < \text{BMI} < 29.9$ ,  $N = 238$ ). All displayed path coefficients are significant ( $p < .05$ ). The direct path from fatness to cuteness is non-significant and not shown.

that, despite its association with a positive appraisal, perception of babyishness is strongly related to the negative trait most central to stereotypes about overweight people – laziness. This pattern is consistent with our hypothesis that the latter trait attribution is influenced by a negatively evaluated discrepancy between the physical and behavioural features required for adults, on the one hand, and their perceived babyishness on the other.

It should be noted that judgement of beauty may be partly based on judgements of cuteness (cf. Cunningham, Barbee, & Pike, 1990). Indeed, the general aesthetic preference for curvature (Bar & Neta, 2006) may be partly due to its association with characteristically round baby features. Perhaps, this may also be a reason why circularity due to muscularity and ratings of muscularity are associated with both beauty and cuteness.

An important limitation of the present study should be emphasized. In particular, the reliance on correlations makes it impossible to claim causal relationships between the measured variables. Thus, the path model presented earlier should only be interpreted as a convenient way to examine unique and shared variances among the measured variables. Furthermore, rather than being directly derived from certain physical similarities with babies, perceived babyishness may be an inference based on existing negative stereotypes about overweight and obese individuals; that is, to the extent that these stereotypes refer to laziness or lack of willpower, an association with immaturity and childlike behaviour is easily made. However, even if true, physical baby features could still be important for confirming the validity of these stereotypes. Moreover, a completely stereotype-based account of the present data cannot easily explain why, up to a certain point, perceivers associate fatness and babyishness with the positive appraisal of cuteness.

In sum, it is clear that experimental methods should be used to further support the hypothesized causal relationships and to examine whether particular body parts of overweight males are especially influential in causing an impression of babyishness. One promising avenue would be to prime research participants with (parts of) pictures of babies and of normal, overweight, and obese individuals, and to examine to what extent these pictures (or their specific parts) are capable of activating concepts related to cuteness, tenderness, and protection. Another would be to use neuroimaging techniques to establish if, in responding to overweight and obese individuals, the same neural structures are involved as in responding with care and tenderness to babies (cf. Zebrowitz, Luevano, & Bronstad, 2009).

Future research should also examine three other issues which could not be addressed by the present study. First, as theorized in the introduction, we expected perceived babyishness primarily to have negative and stigmatizing consequences for perceivers in individualistic Western countries who strongly value long-term health consequences and personal responsibility. Yet, to test this, future studies should explicitly compare responses to normal and overweight individuals in different cultures.

Second, we also theorized that body fatness in females may be more strictly judged in terms of beauty than fatness in males (Crossley, Cornelissen, & Tovée, 2012). Alternatively, the former may be more strongly associated with fertility and successful motherhood (Brown, 1991), and hence more with a caregiving than care-receiving role. Consequently, overgeneralization of baby features and its influence on stereotyping seem less likely when judging overweight females. Again, this should be explicitly tested by including both male and female stimuli.

Third, we doubt that the present hypothesis can be easily applied to the judgement of facial features. Although moderately chubby cheeks of adult faces are known to be optimally attractive (Coetzee *et al.*, 2009), and facial fatness may result in rounder and apparently larger and hence more babylike heads, an increase in fatness may also deform the face and reduce the resemblance with a baby face. For example, compared to other facial areas, the forehead of an obese individual may appear relatively less high due to a gradually disappearing chin and hence apparently larger lower facial area. Similarly, the eyes will appear smaller when the total facial area increases. Suggesting that facial expression is also relevant to consider, Windhager, Patocka, and Schaefer (2013) found that, compared to thinner individuals, obese girls have a relatively downward turned corner of the mouth. These complex perceptual and affective consequences of facial adiposity may explain why Zebrowitz *et al.* (2003) were unable to find clear evidence for a baby-face overgeneralization effect for the faces of overweight adults.

The present account of reactions to overweight people has the following theoretical and practical implications. First, if visual exposure to adipose bodies relatively unavoidably triggers a motivational mechanism with certain perceptual consequences, it could help explain why responses to overweight individuals are difficult to influence by providing verbal information about the non-behavioural and environmental causes of fatness (Danielsdottir, O'Brien, & Ciao, 2010).

Second, the present theory provides an explanation for the finding that stereotypes about adipose individuals not only contain negative but also positive traits such as agreeableness and kindness (Butler *et al.*, 1993) and even 'huggability' (Shoneye, Johnson, Steptoe, & Wardle, 2011).

Third, the present perspective explains why people tend to take overweight and obese individuals less seriously and make fun of them, not only in a malevolent but also benevolent manner (Chou *et al.*, 2014; Yoo & Kim, 2012). Although there are different



psychological theories of humour (Martin, 2007), one that seems especially relevant here is based on interactions between caregivers and infants. In particular, it has been argued that infants unexpectedly showing marks of adult behaviour (and engaging in 'clowning') are experienced as both cute and funny by caregivers, resulting in aggression inhibition and increased affection (Reddy, 2001). Taking this a bit further, the same process may explain why adults saliently showing infantile behaviour (a strategy commonly used to reduce aggression during play or by comedians), or who are physically vulnerable yet without clear evidence for suffering (Dijker, 2014), such as the obese, are similarly experienced as funny. Combined with negative trait attributions, however, humour may increasingly get more malevolent and stigmatizing (Burmeister & Carels, 2014).

If future research would support its validity, a practical implication of the present hypothesis would be to increase attention to the manner in which overweight and obese individuals visually appear in the media and in public campaigns. For example, by means of grooming, clothing, and demeanour a lot can be done to strongly disconfirm impressions of babyishness and immaturity.

To conclude, what has been proposed in the present paper with respect to reactions to overweight individuals can be considered a 'double mismatch' hypothesis. While fatness in adults must have been relatively rare but adaptive in the unpredictable and food-scarce environment in which humans evolved, it represents a mismatch between a psychobiological mechanism and our modern and 'obesogenic' environment with easily obtainable, calorie-dense food and little need for physical activity (Power & Schulkin, 2009). The increasingly frequent confrontation with overweight and obese adults under modern conditions of living, however, may cause another kind of mismatch, as it may prime humans to misapply a psychological mechanism specifically evolved to respond adaptively to babies and infants, resulting in potentially stigmatizing effects in modern Western and individualistic societies.

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## Appendix A:

Numbers of the photographs selected from *Atlas of men* (Sheldon et al., 1954).

8	124	251	374	511	683	845	953	1,059	1,137
12	125	252	385	512	694	846	955	1,060	1,138
14	130	253	401	514	695	847	961	1,064	1,139
17	166	254	402	515	700	856	964	1,066	1,140
24	168	258	404	518	715	858	965	1,068	1,141
26	170	260	405	530	716	861	969	1,072	1,144
29	171	264	411	545	719	865	972	1,078	1,152
30	173	268	417	548	743	876	976	1,080	1,153
31	176	273	419	549	745	878	979	1,084	1,154
37	181	274	422	550	746	881	984	1,086	1,155
38	182	277	424	553	757	884	988	1,088	1,159
40	186	285	437	558	758	894	993	1,089	1,161
42	191	288	443	560	761	897	994	1,091	1,162
46	193	289	450	563	763	901	995	1,095	1,163

Continued

**Appendix A** (Continued)

49	200	292	456	572	766	905	999	1,097	1,164
54	202	300	459	575	773	907	1,007	1,101	1,165
62	215	307	462	576	779	909	1,011	1,103	1,166
65	217	314	463	584	780	917	1,013	1,105	1,170
71	219	318	466	587	794	919	1,014	1,106	1,171
73	225	319	473	588	801	922	1,019	1,110	1,173
80	226	325	480	603	804	923	1,026	1,112	1,174
87	228	326	486	621	807	924	1,030	1,115	1,175
91	231	328	487	635	808	931	1,043	1,118	
94	232	338	496	642	812	933	1,045	1,120	
106	235	341	499	652	816	942	1,046	1,123	
110	240	345	501	654	818	943	1,047	1,125	
113	244	359	502	659	825	945	1,052	1,127	
114	246	361	504	662	829	949	1,054	1,130	
116	248	364	506	673	832	950	1,056	1,134	
121	250	366	508	674	837	951	1,057	1,136	

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**Appendix B:**

**Table B1.** Characteristics of the stimulus photographs selected from Sheldon et al. (1954).

Weight category <sup>a</sup>	Number of photographs	BMI <sup>b</sup>		Endomorphy <sup>c</sup>		Mesomorphy <sup>c</sup>		Ectomorphy <sup>c</sup>	
		M	SD	M	SD	M	SD	M	SD
Underweight (BMI ≤ 18.5)	17	17.76	0.57	1.35	0.49	2.06	0.43	6.41	0.51
Normal weight-1 (18.6 ≤ BMI ≤ 21.9)	73	20.46	0.92	2.51	0.96	3.34	1.10	4.56	0.87
Normal weight-2 (22 ≤ BMI ≤ 24.9)	84	23.46	0.88	3.36	1.35	4.21	1.40	2.76	0.75
Overweight (25 ≤ BMI ≤ 29.9)	81	27.05	1.44	4.51	1.48	4.14	1.64	1.68	0.70
Obese (BMI ≥ 30)	37	34.79	5.09	6.24	0.83	3.35	1.27	1.41	0.55

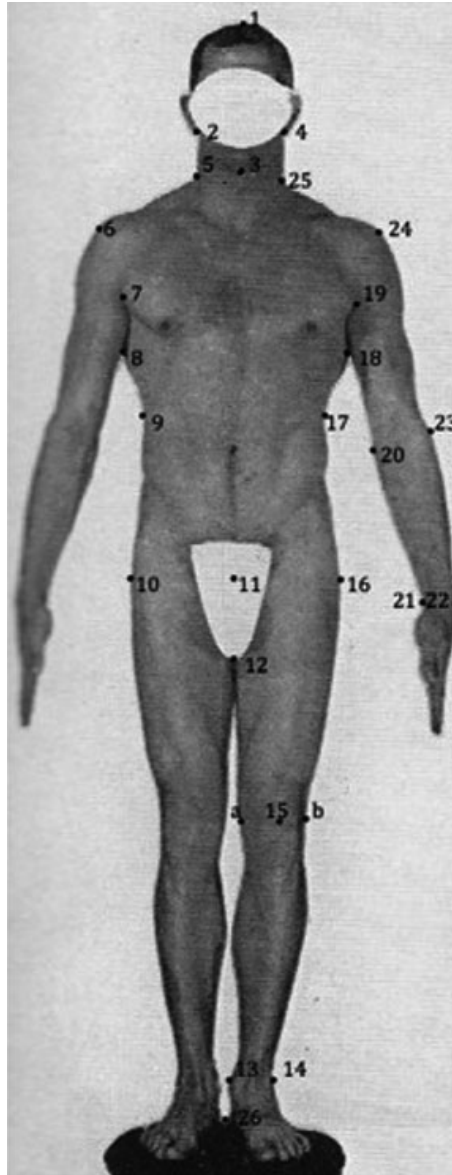
<sup>a</sup>Categorization is based on Leonard (2012).

<sup>b</sup>BMI calculated from Sheldon et al.'s (1954) 'Height-to-Weight ratio' (see Method section).

<sup>c</sup>Endo-, meso-, and ectomorphy are expressed on scales from 1 to 7 (Sheldon et al., 1954).

## Appendix C:

Placement of the landmarks on the photographs and measurements taken.



### **Length measures**

Body height: distance between 1 and 26.

Head length: distance between 1 and 3.

Neck width: distance between 5 and 25 (these points represent the visually sharpest angle between trunk and neck).

Neck height: average of distances between 2 and 5, and 4 and 25, respectively.

Shoulder width: distance between 6 and 24 (left and right acromion, respectively).

Arm length (left side only): distance between a point located halfway between 21 and 22 (left and right processus styloideus radialis, respectively) and 24 (left acromion).

Leg length (left side only): distance between a point located halfway between 13 and 14 (malleolus medialis and malleolus lateralis, respectively) and a point located halfway between 10 and 16 (left and right trochanter major, respectively).

Waist length: distance between 9 and 17 (visually representing the smallest diameter of the trunk).

Hip length: distance between 10 and 16 (left and right trochanter major, respectively).

### **Perimeter and surface measures**

Head: curved surface enclosed by 1, 2, 3, and 4 (ears included).

Trunk: curved surface enclosed by 5, 6, 7, 8, 9, 10, 16, 17, 18, 19, 24, and 25.

Upper arm (left side only): curved surface enclosed by 19, 18, 20 (epicondylis medialis humerus), 23 (epicondylis lateralis humerus), and 24 (acromion).

Lower arm (left side only): curved surface enclosed by 20 (epicondylis medialis humerus), 21, 22, and 23 (epicondylis lateralis humerus).

Upper leg (left side only): curved surface enclosed by 11 (point located halfway between 10 and 16 and directly above 12), 12, 15a (right of patella), 15b (left of patella), and 16.

Lower leg (left side only): curved surface enclosed by 15a, 13, 14, and 15b.