AN EVOLUTIONARY APPROACH TO HUMAN SOCIAL BEHAVIOUR: THE CASE OF SMILING AND LAUGHING

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by

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ABSTRACT

Living in large groups is, for many species, an adaptive solution to survival and reproductive issues. It followed that in primates, and even more so humans, communication evolved into a complex signalling system that includes language, non-verbal vocalisations such as laughter, and facial expressions. A series of studies were designed to address the function of smiling and laughter through an analysis of context and consequences. First, naturalistic observations were conducted in areas where people could be watched interacting in stable social groups. Focal sampling of men and women allowed the recording of smiling and laughter frequencies, as well as other interpersonal aspects such as talking and listening time, and body contacts. Smiles were classified in two categories: spontaneous and forced. A test based on predictions derived from three hypotheses (mate choice, social competition, and cooperation) revealed that spontaneous smiling and laughter are likely to be involved in the formation of cooperative relationships. A closer examination of dyadic interactions revealed that smiling was related to talking and listening time, whereas female's vocalised laughter positively affected the partner's speech output. Finally, smiling and laughter rates increased the probability of observing affiliative body contacts between individuals. A second set of studies investigated the possibility that smiling could (1) advertise attributes relevant to the formation of social relationships, and (2) be a honest signal of altruistic dispositions. The assessment of various traits was examined through people's judgments of neutral and smiling photographs. Results showed that smiling faces were perceived as being significantly more attractive, more generous, healthier, more agreeable, more extroverted, and more open to experiences than their neutral counterparts. Interestingly, men were influenced by smiling in a much larger extent than women, particularly when smiling faces were female's. The rating study also revealed that people who displayed smiles involving an emotional component (Duchenne smiles) received higher scores on extroversion and generosity than people who did not, indicating that people's ratings of sociability and generosity are sensitive to facial movements that are not easy to produce on purpose. A final study investigated the effect of bargaining contexts on smiling and laughter rates between friends. Analysis of videotaped interactions showed that Duchenne smiling and vocalised laughter were displayed at significantly higher rates when people were involved in the sharing of material resources (as opposed to a control interaction). Moreover, data confirmed that Duchenne smiling could be a reliable signal of altruism, as its frequency of occurrence in the bargaining interaction was positively affected by measures of altruism. Finally, results showed that smiling and laughter could advertise personality traits as well as aspects of the relationship between sender and receiver. All in all, the present thesis indicates that smiling and laughter could be used adaptively to develop social alliances, and that this bonding process would entail the reliable advertisement of evolutionarily relevant attributes. The relevance of smiling to a behavioural style based on cooperation and prosocial activities is also discussed.

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Chapter One

INTRODUCTION

One of the main principles of evolutionary theory is that the ability to deal with biologically relevant information is crucial for any organism's endeavour to survive and reproduce. In primates, the formation of large groups has been identified as one of the most successful evolutionary responses to face environmental pressures such as predation and the exploitation of resources (Dunbar, 1996b). However, group living not only provided benefits, but also imposed costs such as increased competition for resources like food and mating partners, or aggression from group members. As a result, group living became one of the major environmental pressures that individuals had to adapt to, and is believed to have shaped the evolution of brain structures in primates (Humphreys, 1976; Byrne & Whiten, 1988a; Dunbar, 1998). This claim constitutes the core of the social brain hypothesis, which construes that the ability to build mental representations of social events, to infer relevant meaning to these events and to relate those processes to appropriate responses are all evolved properties of primate brains (Dunbar, 1998).

Within the primate order, humans have developed a sophisticated sense of sociality, and communication became one of the most significant means of biological adaptation to be selected for during evolution. Because behaviour can be considered as the interface between an organism and its environment (Lorenz, 1978), it is often the means through which selection pressures act on individuals, and ultimately on the genes carried by them. Therefore, behaviours involved in communication are particularly important in primate and human evolution because they provide individuals with 'equipment' to face one of the most relevant parts of their natural environment: the social world.

Smiling and laughter will be regarded here as parts of a communication system that evolved to help individuals deal with their social environment (Andrew, 1963; van Hooff, 1972; Fridlund, 1994). The main concerns of this thesis are first, to specify the context in which smiling and laughter occurs, and second, to evaluate the social consequences of these behaviours. As prescribed by the ethological method (Hinde, 1975), these two steps should bring us on the track towards a better understanding of smiling and laughter. However, before discussing laughter and smiling specifically, the following pages will introduce the theoretical framework that is used to explain the nature of these behaviours, and their importance in social relationships.

1. Animal signals

The nature of animal signals has been extensively discussed in the literature. The traditional ethological approach construed signals as discrete and deterministic, i.e. each part of a signal carries a particular meaning that is responsible for the release of a specific reaction (Lorenz-Tinbergen approach). This view implied that a signal and its response are intrinsically connected, in the same sense that a key is linked to its particular keyhole. Moreover, for the signal to function appropriately as a releaser, a certain consistency is required to ensure that it is recognised by the receiver independently of the surrounding 'noise', i.e. in many different situations. In order to increase their distinctiveness, social signals are believed to have formalised into discrete and meaningful sequences of behaviour through an evolutionary process called ritualisation (Tinbergen, 1952; Huxley, 1966).

Ritualisation is a concept developed by early ethologists to describe how sequences of behaviour acquire a social function over evolutionary time (Tinbergen, 1952; Huxley, 1966). Essentially, ritualisation can be conceived as a modification, over the course of evolution, of incidental actions to improve their effectiveness as signals. The modification is often aimed at displaying a prominent body structure or is designed to make the actions themselves more conspicuous. As a result of physiological changes, the movement becomes stereotypical, repetitive, and exaggerated. Therefore,

ritualisation can be seen as a schematisation of behaviour that is adapted to the receiver's ability to process the signal, and that is more efficient in releasing a particular response in the receiver. In the human behavioural repertoire, facial expressions and laughter are believed to have undergone such a process of ritualisation (Grammer & Eibl-Eibesfeldt, 1990; Fridlund, 1994). According to this view, ritualised signals play a critical role in the adaptation of individuals to their social environment.

1.1. Manipulation and Mind-Reading

Investigating the function of animal signals has been an important theme of ethological research during the past decades (Maynard-Smith & Harper, 2003). The word 'signal' generally refers to the means by which individuals communicate various types of information to other individuals from the same or a different species. The traditional view of animal communication implies that signals transfer information, which aims at reducing the observer's uncertainty about the sender and receiver's future behaviour (McGregor, 2005). Thus, signals would evolve because the receiver can gain semantic information about the sender.

However, recent trends in ethology argue that social signals have a different function than the mere transfer of information between individuals (Krebs & Dawkins, 1981). Instead, signals would be aimed at influencing the behaviour of other individuals to the reproductive advantage of the sender (*ibid.*). Krebs and Dawkins (1981) claimed that the function of a social signal is to act on other individuals' perceptual system: "Just as a wing performs its normal function by working on the air, so a signal performs its normal function by working on another animal via its sense organs" (p. 380). In other words, the signal's function would be the modification of other individuals' behaviour to the advantage of the sender.

Social groups appear to be complex structures whose main feature is that the goals of its members are rarely in accordance. In such agglomerations of conflicting interests, deception is likely to occur and proliferate as a strategy for individual members, whenever they can easily obtain survival and reproductive benefits from others.

Subsequently, social exploitation will evolve if the pay-offs associated with deception are higher than those associated with the communication of "authentic" information (Krebs & Dawkins, 1981). In other words, deceptive signals will evolve when the sender benefits more from provoking a response that is advantageous for the sender rather than from communicating reliable information about its intentions, its internal state, or the environment. Therefore, during the course of evolutionary time, those signals (or displays, in the case of behavioural pattern) that succeeded in manipulating other individuals have been selected (against those that didn't) and therefore were represented in greater proportions in future generations (*ibid.*).

Nevertheless, increasing rates of sensory exploitation create a selection pressure for receivers to evolve an ability to detect manipulative deception: to engage in 'mind-reading' (Krebs & Dawkins, 1981). Because each individual has the possibility either to send or to receive signals, it is important to note that 'manipulation' and 'mind-reading' refer to roles (i.e. sender or receiver), or strategies that each individual may assume interchangeably during a single interaction. The evolution of social signals is the product of an arms race between manipulator and mind-reader, where each role change becomes a new selection pressure for the other to evolve.

The co-evolution between manipulator and mind-reader depends on the distribution of profits between the protagonists. As a matter of fact, the benefits of communication can be mutual. For example, it has been shown that under particular conditions, kinship (Hamilton, 1964) and reciprocity (Trivers, 1971), cooperation can be favoured by selection and result in the co-evolution of a different kind of signalling and detection ability. Indeed, if the receiver benefits from the signal, there is no need to develop a particular resistance to it; but a higher sensitivity to this kind of signal would be expected to evolve instead (Krebs & Dawkins, 1981).

Since signals can be costly (in energy, and in the risk of being detected by predators or competitors), the increased sensitivity to cooperative signals could lead to a reduction in amplitude and attractiveness of these signals, sometimes called 'conspiratory whispers' (McGregor, 2005). However, in order to face the constraints of

discriminability and detectability, cooperative signals should evolve towards a compromise between detectability and economy, while non-cooperative signals should achieve a balance between economy and efficiency at producing a response in other animals. This implies that co-evolution of cooperative interactions should lead to cost minimizing muffled signals, whereas co-evolution of non-cooperative communication should result in conspicuous, loud and repetitive or ritualised signals, aimed at breaking through an individual's perceptual system (Krebs & Dawkins, 1981).

1.2. The Handicap Principle

The possibility of cooperative signalling implies that signals are not always aimed at manipulating other individuals. Zahavi (1975, 1987) suggested that the function of animal signals is to send reliable information about underlying dispositions, which can be beneficial for both the sender and the receiver. This view assumes that signals are designed to be honest indicators of an animal's genetic quality with respect to some attribute that a receiver has an interest in. According to Zahavi, it is the cost of the signal itself that ensures its honesty. The development and the maintenance of a costly signal are mediated through the underlying quality that the signal is meant to advertise. The efficacy of the handicap is to discourage dishonest signalling, because individuals without the underlying dispositions (cheaters) would decrease their fitness if they were to take on the handicap. In most cases, the feature is functionally useless and can even be counterproductive to survival (e.g. the peacock's tail). Precisely, the presence of a costly and useless character indicates to others that if the holder can survive despite the handicap it bears, its underlying quality must be greatly valuable. This is referred to as the 'handicap principle' (Zahavi, 1975).

Mathematical modelling showed that signals providing reliable information about an organism's constitution are likely to be maintained in the population when the costs to mimics are too high in comparison to the benefits of honest cues (Grafen, 1990). The evolutionary mechanisms responsible for the maintenance of reliable signals are therefore related to the balance between costs incurred by senders and receivers. Verhencamp (2000) summarized five ways in which signals can be costly (cited in

Brown & Moore, 2002). First, signals can be costly to the sender as a result of physiological or physical constraints (such signals are also known as index signals). In this case, signal design is linked to the sender's attributes (e.g. age and sex). Second, there are costs related to genetic aspects underlying the production of the signal. Here, the intensity of the signal is an indication of the sender's genetic quality (e.g. the peacock's tail). Third, there are proximate physiological aspects underlying the production of the signal which informs about the sender's immediate needs (e.g. thirst or hunger). Fourth, there are costs imposed by the receiver's ability to process the signal, and by its reaction to the signal (Guilford and Dawkins, 1995). These costs can, for instance, put the sender at risk from receiver and predator attacks. Finally, there are costs imposed when the receiver punishes a mimic. This last point particularly applies to human groups, in which arbitrary and conventional signals can be easily mimicked. In this case deceptive information is heavily punished by receivers when the convention is violated. All in all, the mechanisms responsible for the evolution of honest signalling are related to costs inherent to the sender and to costs imposed by the receivers. Either way, the signals will be reliable if there are costs preventing deceit.

2. Human Non-Verbal Behaviour

Human language abilities do not function in a vacuum. It is likely that such an elaborate system of information transfer originated and evolved in parallel with more ancient means of communication. Psychological research conducted over the past decades showed that non-verbal behaviour plays a central role in the regulation, structure, and meaning of human social interactions (Argyle, 1988; Beattie, 2003). Evolutionarily speaking, non-verbal behaviour is seen as a communication system involved in the exchange of adaptive information (Eibl-Eibesfeldt, 1989). Moreover, the deep roots of that system suggests that it shares properties with animal signalling (Hinde, 1972). Non-verbal behaviour includes gestures, facial expressions, gaze, posture, body contacts, smell, non-verbal vocalizations, and spatial behaviour. It also entails clothing and other aspects of appearance such as hair dress, body care, etc. Non-verbal behaviour can be closely related to emotional processes and is often used

to express interpersonal attitudes, but also to support speech, to introduce oneself, and to proceed to various rituals such as greetings (Ekman & Friesen, 1969; Morris, 1977; Argyle, 1988).

2.1. The Function of Non-Verbal Behaviour

As for any other selected traits, the function of behaviour relates to its capacity to positively affect the reproductive success of the individual who displays it, and therefore increase the frequency of the genes underlying the structures that make behaviour possible (Dawkins, 1976). Given that sociality is a central aspect of primate life (Dunbar, 1988), it is likely that non-verbal cues evolved as parts of a communication system aimed at solving social problems. Consequently, two factors are relevant for understanding the function of non-verbal behaviour: (1) the social environment in which it occurs, and (2) its interactive consequences.

In order to succeed in the social environment, individuals have to know the identity of others (e.g. age, gender, kinship, social status, etc.), their past behaviour, as well as their current dispositions and intentions (Dunbar, 1988; Barton & Dunbar, 1997). Because behaviour is directly available to observation by conspecifics, it is likely to be the main channel through which people acquire knowledge about each other. A concept that can be particularly useful for understanding the role of non-verbal behaviour in social interactions is the *resource holding potential*, or RHP (Parker, 1974). This concept refers to an individual's ability to make a successful challenge or to effectively defend against rivals. RHP is defined by size, strength, skills, previous success, allies, and other factors that increase fighting or winning capacity (*ibid.*). Ethologists have argued that the communication of RHP is essential to make adaptive social decisions, for example to avoid engaging in conflicts that are likely to be detrimental to survival (Krebs & Davies, 1993). The communication of RHP is performed in agonistic interactions by means of behavioural rituals, and has later evolved into non-verbal displays of social status.

In primates, and especially humans, desirable outcomes are not exclusively achieved with the help of agonistic behaviour. Instead, individuals seem to make their way in the social world via the advertisement of attractive qualities leading them to be selected by others as ally or as mate (Gilbert *et al.*, 1995). As opposed to RHP, which is mainly confined to the context of agonistic interactions, the capacity to direct favourable attention to the self has been called *social attention holding power* (SAHP) by Gilbert (1989). This ability is an alternative form of status acquisition to that of aggression and threat, and is believed to be communicated non-verbally (Gilbert *et al.*, 1995). Therefore the advertisement of SAHP, and to some extent RHP, could be an essential aspect of human social behaviour because it helps individuals compare each other. Social comparisons, in turn, enhance adaptation of people's behavioural strategies to the particularities of the social environment.

2.2. Evolutionary Constraints on Non-Verbal Behaviour

As mentioned earlier, signals can be manipulative or cooperative depending on the distribution of pay-offs between the sender and receiver. These pay-offs are often associated with the type of information available from the signal. The kind of information conveyed by non-verbal behaviour has been at the centre of most studies on the topic. Past research suggest that non-verbal cues could advertise internal states such as emotions (Darwin, 1872; Ekman, 1982), or cognitive appraisals of a specific situation (Scherer, 1992). Non-verbal cues could also signal future intentions and tendencies to (re)act in a certain context (Hinde, 1985; Fridlund, 1994). Another possibility is that non-verbal signals do not reflect particular information but act to change the receiver's internal state by means of sensory exploitation (Owren & Bachorowski, 2003). This last proposition is reminiscent of the view defended by Krebs and Dawkins (1981) about deception; and seems rather plausible, given the existence of psychological adaptations designed to gain information from other individuals' behaviour and to react accordingly (Barkow *et al.*, 1992; Barrett *et al.*, 2002). Indeed, the existence of mechanisms that react automatically to social stimuli leaves the door open to the evolution of strategies based on social exploitation. If all these options (communication of internal state, cognitive appraisals, and intentions, or

deception) could potentially increase a signaller's reproductive success, then all of them could have evolved within a population, yet each under different selective pressures.

The balance of pay-offs between sender and receiver could represent a continuum with manipulation and cooperation at the extremes. This implies that at least two factors have driven the evolution of social behaviour: (1) constraints inherent to the individual producing the signal, and (2) selective pressures related to receiver psychology (i.e. social perception). It is therefore important to distinguish what motivates the behaviour itself from what can actually be inferred from it. This distinction reflects two sources of costs associated with signalling behaviour: controllability and mind-reading.

Mind-reading skills allow individuals to make predictions about the behaviour of others. Given that social groups are composed of individuals with different interests, individuals who are able to decode others' internal states and thereby predict their actions will accrue an advantage over those who cannot. Transparent communication of one's own intentions becomes therefore risky, because the receiver can directly act against the sender and prevent him from reaching his goals. Similarly, as soon as the receiver recognizes the sender's intentions, the possibility of manipulation arises. This results in an intricate situation where people need to simultaneously conceal their intentions while trying to expose relevant information (Grammer *et al.*, 1997). A more flexible control over one's own behaviour would therefore allow individuals to adapt to social environments that include skilled mind-readers. On the other hand, mind-reading abilities should be flexible enough to avoid exploitation by individuals who developed elaborate behavioural tactics.

Research into non-verbal behaviour suggest that the tactic of signalling clearly yet subtly could be solved by using meta-communicative signals (Grammer, 1995). According to this view, 'natural' signals sent in parallel would include the instructions necessary to decode a signal. For example, the combination between age and sex of the sender could mediate the meaning of a smile from a simple friendly expression to a sexual invitation (*ibid.*). Hence, it is important to take into account the sex of sender

and receiver when assessing the effect of behaviour on person perception. The multi-modal properties of social signalling most probably co-evolved in the course of an evolutionary arms race in which selection pressures imposed by social exploitation have put pressure on receivers to develop mind-reading skills capable of dealing with multi-channel communication. As a result, evolutionary constraints on the control of non-verbal behaviour might have, in turn, driven the evolution of increasingly complex cognitive processing. Not surprisingly, the brain mechanisms underlying multi-level social cognition are the objects of hearty debates in neuroscience (see Beer & Ochsner, 2006).

2.3. Self-Regulation of Non-Verbal Behaviour

If non-verbal behaviour carries important information, an interesting question is to ask whether people could use it to claim a variety of self-relevant characteristics. In other words, will people attempt to consciously regulate and control their non-verbal behaviour to create a particular impression on others? Many studies showed that people use non-verbal strategies to achieve self-presentational goals (for a review, see DePaulo, 1992). For example, students who want to ingratiate themselves to their professor can nod, smile, and show an expression of fascination throughout each talk (Rosenfeld, 1966; Purvis *et al.*, 1984). However, intrinsic properties of non-verbal behaviour might prevent the intention to regulate one's own expressions for self-presentational purposes. Indeed, there are a number of constraints (or costs, in the language of animal behaviour) associated with the management of non-verbal displays.

Among the constraints that thwart the conscious control of non-verbal expressions, there is the fact that people rarely formulate conscious intentions to produce certain kinds of non-verbal performances. Another constraint is that motives cannot always be translated into non-verbal behaviour because the behaviours are too difficult to produce at will (DePaulo, 1992). Many other reasons add to the complexity of controlling one's own behaviour. For example the fact that non-verbal performance is irrepressible: try as they might, people cannot refrain from behaving non-verbally. In addition, others will form automatic judgements based on the behaviour they observe.

This is irrepressible too, and occurs irrespectively of whether the observer or the target wants it to happen or not (Kleck & Strenta, 1980).

Another constraint is that non-verbal behaviour is strongly connected to emotional and physiological processes. Most major theorists of emotion have proposed that the existence of hard-wired links between the elicitation of basic emotions and the triggering of facial muscles produces the expression of those emotions (Tomkins, 1962; Ekman, 1972, 1977; Izard, 1977). These strong connections between emotion and behaviour would make the *voluntary expressions* of 'genuine' emotions very difficult. Additionally, it has been argued that the perceptual apparatus involved in the detection of emotional information is also hard-wired and proceeds without any contribution of higher cognitive processes (Buck, 1988; Mac Arthur & Baron, 1983). This suggests that some aspects of both behaviour and social perception are automatic and function below awareness threshold.

Limitations in the control of non-verbal displays also include the fact that behaviour is less accessible to the actor than to observers. Although interactants sometimes provide feedback about people's expressive behaviour (Ekman & Friesen, 1969; Buck, 1988), people cannot see their face or hear their voice in the same way other persons can. This makes it awkward for them to regulate their own behaviour on a moment-to-moment basis so as to convey just the desired impression. The fact that non-verbal behaviour is *off-the-record* is another property that makes its control more ambiguous. Indeed, it is more difficult to describe and to recall a facial expression or a tone of voice than it is to recount spoken words. This indirectness of non-verbal behaviour contributes to the flexibility with which it can be used and interpreted.

Finally, it is important to note that these properties are not equally valid for all types of non-verbal cues. For example, facial expressions and the tone of voice are more strongly related to emotions than spacing behaviour or body contacts. Therefore, non-verbal displays differ in the kind of attributes and features that characterize them and their expression varies systematically along a continuum of controllability (Ekman & Friesen, 1969; Rosenthal & DePaulo, 1979). The constraints on non-verbal behaviour

mentioned earlier are paralleled by the costs that usually apply to animal signalling (see previous section). Therefore, it is likely that individual differences in behavioural strategies largely determine the extent to which people can overcome these constraints (or costs) in order to regulate their own behaviour. For example, some people are particularly gifted at exercing voluntary control over emotional cues (Ekman, 1985). Similarly, professional actors are good examples of how flexible non-verbal behaviour can be. Evolutionary theory entails that these individual differences have been maintained by the selective advantages that followed the perfomance of certain behavioural strategies during human phylogenetic history.

2.4. Sex Differences in Non-Verbal Behaviour

Men and women have different approaches to social relationships, and it is likely that different aspects of personality are emphasized when people interact with same-sex or opposite-sex individuals. Past meta-analyses found moderate sex differences in a variety of behaviours, the effect depending on the context of occurrence and the type of behaviour considered (Hyde, 2001). In addition, women seem to be particularly sensitive to non-verbal cues, indicating that they might read somehow 'more accurately' other people's body language (Rosenthal, Hall, DiMatteo, Rogers, and Archer, 1979; Hall, 1984; Argyle, 1988; Hall & Matsumoto, 2004). Sex differences in the display and perception of non-verbal behaviour could therefore reflect differential adjustments made by males and females to particular situations. Similarly, these sex differences could reveal the different emphasis placed by men and women on the social characteristics deemed relevant to a certain context.

According to evolutionary theory, sex differences in psychology and behaviour result from differences in the strategies used to achieve reproductive success (Trivers, 1972). In sexually reproducing species, mammals in particular, females always invest more than males in the production of offspring. Physiological costs, including the production of eggs, internal fertilisation and gestation are disproportionately larger for females than for males. These costs imposed a limit on the maximum number of offspring that a female could produce in a lifetime, therefore making female's reproductive success

more dependent on the quality of progeny rather than on copulation frequency. On the other hand, a relatively low physiological investment in males resulted in their reproductive success being largely determined by the number of females they could fertilise. Different mechanisms in the physiology of reproduction therefore gave rise to sex differences in behaviour, implying that females focus their investment on producing a few but high-quality offspring, while male concentrate their efforts on copulation frequency (Trivers, 1972; Barrett, Dunbar, & Lycett, 2002).

This traditional view of mating strategies led to the assumptions that males compete for the limited resources that fertile females represent for them, whereas females tend to look for and choose high-quality males in order to increase their chances of having high-quality offspring. However, reproductive success is not restricted to mating attempts but is also the result of successful rearing of the progeny. Thus, individuals should also engage in parental investment in order to guarantee an optimal development for their offspring and hence, influence their chances of producing the greatest number of grandchildren (Trivers, 1972; Barrett *et al.*, 2002). Although females' parental investment is generally greater than males', the high rearing cost of human infants imposes a strong selective pressure in favor of paternal investment. The net advantage incurred by males who engaged in paternal care therefore led to a more balanced equilibrium between males' and females' parental investment and reproductive strategies.

Since genotypic and phenotypic traits that favour reproductive success are distributed unequally in the population, the selection of an appropriate mate became an essential theme in individual's social life. Indeed, if organisms were equally fertile and willing to invest resources in the progeny, there would be no need to be selective in the choice of reproductive partners. In this context, it is useful to keep in mind that the balance between intra-sexual competition and 'choosiness' is often determined by the individual who invests more in offspring, rather than by sex *per se* (Trivers, 1972). Hence, even though males still compete for fertile females, they are choosier in the selection of long-term partners due to increased paternal investment. On the other hand, females engage in intra-sexual competition for partners who are able to invest

greater resources in their offspring (Campbell, 2002). Because the advertisement of mate value increases the range of possible partners (i.e. more receivers), and because males and females favour different traits in the selection of partners, it is likely that sex-specific advertisements for phenotypic traits that signal mate quality evolved and took different forms, from morphology (Barber, 1995) to behaviour (Moore, 1985; Renninger *et al.*, 2004).

Although crucial to reproductive success, mate choice is not the only social sphere in which people could benefit from advertising personal qualities. Within the realm of social life, finding the right allies might also be crucial to achieve reproductive goals (Dunbar, 1988). As a result of sex differences in reproductive strategies it is expected that males and females also differ with regards to coalition formation. Males tend to be more goal-oriented in their choice of allies and their alliance is often motivated by the acquisition of status which in turn gives them greater mating opportunities (de Waal, 1982; Mealey, 1985). On the other hand, females are inclined to emphasise the quality of their relationships and create cooperative networks centred on the exploitation of resources (Wrangham, 1980). If both men and women benefit from cooperation, the sex difference could lie in the duration of relationships, with females having longer and more stable partnerships than males (Campbell, 2002).

Given the distinct selective pressures to which males and females have been exposed in their evolutionary past, it is not surprising to observe sex differences in the expression and perception of social displays. The higher sensitivity to non-verbal behaviour in women (Hall *et al.*, 2000; McClure, 2000) could have evolved as an ability to perform more careful social judgments. This would result from the fact that costs associated with risky social choices are usually larger for women than for men, whether these choices are made in the selection of mates (Grammer, 1989), or in friendship (Campbell, 2002). As well as being better decoders of non-verbal behaviour, women have also been coined as better senders of signals that foster not only the acquisition of social knowledge but also the building of intimate and close relationships. For example, Grammer (1990) showed that women can use subtle non-verbal cues such as postures and laughter in order to elicit the disclosure of information

by potential partners. In addition, women usually demonstrate greater involvement in conversations than do men by showing a more expressive behavioural style (Hall, 1984). All in all, women seem to be specialists in the management of subtle behavioural cues that allow a safer control over the social environment.

2.5. Facial Behaviour

As a result of its great diversity of expressions, the human face is a primary source of information on social interactions, as well as a major component of the non-verbal signalling system (Ekman, 1982; Argyle, 1988; Fridlund, 1991a). Facial displays result from facial muscle activity, some of which are under voluntary control and some which are not. The complexity of the facial muscular system allows the expression of a wide range of different appearances, making the interpretation of facial expressions rather confusing. Despite the ardent debates over the question of whether facial behaviour has a social function or not (Fridlund, 1991a, 1994; Ekman, 1997), it became increasingly difficult to ignore the evidence that facial expressions are adaptations to selection pressures emerging from increasingly complex social environments (Schmidt & Cohn, 2001; Parr, Waller & Fugate, 2005). More precisely, facial expressions could have evolved to communicate internal states, conditional tendencies to react in a particular situation (Hinde, 1985), and cognitive evaluations of the immediate context (Scherer, 1992).

The scientific study of facial expressions began with the nineteenth century French neurologist Duchenne de Boulogne (1862), who published the first *stimulation* studies of facial movements. Duchenne demonstrated the physiological nature of facial actions by electrically stimulating their underlying musculature. Using Duchenne's material, Charles Darwin (1872) went on to investigate the function of facial displays in the first *judgement* studies to date. Darwin's work was the first evolutionary treatment of facial movements. His book *Expression of the Emotions in Man and Animals* (1872) was concerned with the continuity of humans with non-human primates and mammals. Darwin's volume mainly consisted of a catalogue of displays that show resemblance across species, and his views led early ethologists to develop the concepts of

'ritualisation' and 'intention movements'. In addition, by sending questionnaires to travellers around the world, Darwin wanted to document the universality of facial behaviour, with in mind the idea that cross-cultural similarity would suggest shared phylogeny and therefore corroborate an evolutionary account of facial expressions. Nevertheless, Darwin did not conceive facial expressions as social signals but as reflexive habits that evolved for purposes other than communication, for example sphincter actions that regulate vision, olfaction, gustation and respiration (cited in Fridlund, 1991a, p.5).

The modern attempt to apply evolutionary theory to facial behaviour started with ethological studies of non-human primate facial displays (Hinde & Rowell, 1962; van Hooff, 1962, 1967; Andrew, 1963). In opposition to Darwin (1872), Andrew (1963) claimed that facial expressions evolved into exaggerated displays as a result of their communicative value, a position that first applied the concept of 'ritualisation' (Tinbergen, 1951; Huxley, 1966) to the evolution of facial behaviour. The phylogenetic continuity of displays within the primate order was investigated mainly by van Hooff (1962, 1967), whose research consisted of careful descriptions of the morphology of expressions and thorough analyses of the contexts in which they occur. Although many ethologists recognized the importance of emotion in the generation of displays, they insisted on the fact that communication and adaptive consequences were the crucial elements in the evolution of facial behaviour.

Darwin's early views about facial behaviour and the subsequent studies on animal communication made by ethologists led to two distinctive conceptions of facial expressions: the 'Emotions View' (so labelled by Alan Fridlund, 1997) and the 'Behavioural Ecology View' (Fridlund, 1991a, 1994). The 'Emotions View' follows Darwin's early ideas on expressions and regards facial patterns as objective indices of discrete emotional states (Tomkins, 1962; Izard, 1971; Ekman & Friesen, 1971). This stream of research was revived when cross-cultural investigations showed high agreement across Western and Eastern populations in selecting emotion terms that fit facial expressions (Ekman & Friesen, 1971; Izard, 1971). Evidence of universality in recognition led to the postulate that there exist a few basic emotions to which

correspond specific patterns of expressions. Basic emotions would have evolved to help individuals cope with fundamental life-tasks (Ekman, 1992). These emotions are anger, disgust, enjoyment, fear, sadness, and surprise. In addition, Ekman (1992) discussed the possibility that awe, embarrassment, shame, and guilt can be also qualified as basic emotions. According to the 'Emotions View', a particular facial expression is a sign of a corresponding emotion feeling state. Emotion would therefore explain facial behaviour[1]. The theories, methods, and evidence resulting from this approach developed into a 'Facial Expression Programme' that determined most research on facial behaviour and provided the textbook account on that topic. By the 1980s this approach had been largely accepted by psychologists as a major axiom of behavioural science (Russell & Fernandez-Dols, 1997).

In the past years however, an alternative approach emerged in response to the lack of evidence for fundamental assumptions of the 'Facial Expression Programme'. New findings casted some doubts on the 'consecrated' link between facial behaviour and emotion, and sociality emerged as a major player in the production of displays (Kraut & Johnson, 1979; Goldenthal, Johnson, & Kraut, 1981; Fridlund, 1991b). Research into the social function of displays revived the ethological approach to facial expressions and led Alan Fridlund (1991a, 1994) to introduce the 'Behavioural Ecology View', which construes displays as instrumental acts, or evolved signals informing on an individual's social motives. Fridlund (1994) argued that facial expressions are messages that influence others' behaviour because vigilance for and comprehension of the signals co-evolved with the signals themselves. Further, he maintained that this co-evolution could occur only if displays provide reliable and mutually beneficial information about contingent future actions. In addition, evolution would select against any involuntary display of internal state that might betray information detrimental to the signaller (Fridlund, 1997). Because facial displays are the products of a formalised co-evolution with vigilance for them, they do not

[1] Although Ekman (1985) recognised that all facial expressions are not motivated by emotion, he claimed that voluntary expressions are 'false' movements performed to mislead the observer into thinking that an emotion is felt when it is not.

represent 'readouts' of emotions but 'social tools' (Smith, 1977) that aid the negotiation of social encounters (Fridlund, 1997).

The 'Emotions View' and the 'Behavioural Ecology View' represent two distinct positions regarding the nature of facial behaviour. In the 'Emotions View', displays are *signs* that arise by virtue of association with the emotions responsible to cause or accompany them. Although some meaning can be attributed to them, facial expressions did not evolve for a communicative purpose and represent by-products of emotional processes (Ekman, 1997). Alternatively, the 'Behavioural Ecology View' regards facial displays as *signals*, or instrumental acts part of a communication system that evolved to solve adaptive problems pertaining to the social environment (Fridlund, 1991a; 1994). The latter insisted on the fact that facial expressions are not exclusively linked to emotion and could be better explained by factors related to the social context (Fridlund, 1997).

The 'Emotions' and the 'Behavioural Ecology' views are not fundamentally opposed and could just be set to answer questions related to different levels of biological explanation (in the 'Tinbergen sense', Tinbergen, 1963). In fact, there is little doubt that ***both*** emotional processes and social factors are involved in the proximate mechanisms that control the production of a wide range of facial displays (Russell & Fernandez-Dols, 1997). On the other hand, the ultimate function of facial expressions, and non-verbal behaviour in general, is likely to be the regulation of interpersonal relationships (Hinde, 1972). However, as in all scientific disputes, the advocates of each view seem reluctant to concede a single point to their 'opponent'. Even though Ekman (1992) accepted that emotions function to help individuals face fundamental life events, he failed to recognise that most of the basic emotions he proposed are in fact relevant to social contexts and therefore require interpersonal modes of action. In addition, Ekman seems to overlook the proposal that sociality entails most 'fundamental events' that individual primates have to face in their lifetime. Conversely, Fridlund (1994) underestimated the importance of emotionally motivated behaviour in social relationships, among other the proposal that emotional displays

could constitute reliable signals of intentions and dispositions (Hirshleifer, 1987; Frank, 1988).

Beside these two major accounts on facial behaviour, another school of thought also hypothesized on facial expressions without particular claim regarding their evolutionary basis. Nico Frijda (1986) proposed that facial behaviour expresses a *state of action readiness* or *unreadiness*, identifying it as a core component of emotion. Given that emotional processes can strongly condition interpersonal behaviour, the communication of emotional states is important in social interactions. Frijda (1986) claimed that facial expressions represent the means through which individuals relate to their environment at a particular point in time. Moreover, facial expressions would point to the motivational states that produce that relational activity. This is what he calls *states of action readiness*: a readiness to establish, maintain, or change a particular kind of relationship between the signaller and an object that lies in the environment or in thought, or with the environment as a whole (*ibid.*). Frijda's approach is in some way intermediate between the 'Emotions' and 'Behavioural Ecology' views, as he considers that the readiness for emotionally motivated social behaviours is the primary content of facial expressions.

Nonetheless, Frijda's account is complicated by the fact that automatic actions like facial displays are not always underlined by an emotional component but also depends on other factors such as social habits, deceit, voluntary intent, or conversational aspects (Frijda & Tcherkassof, 1997). The issues raised by the multi-faceted nature of facial expressions could be addressed by the 'Componential Approach' (Scherer, 1992; Smith & Scott, 1997). According to that model, each component that contributes to a facial expression pattern (i.e. individual facial actions such as eyebrow raise, or frowns) is inherently meaningful (Smith & Scott, 1997). For example, activity of eyebrow muscles has been suggested to encode information relative to subjective pleasantness (Cacioppo, Petty, Losch, & Kim, 1986; Smith, 1989), perceived goal obstacles, or personal control over a situation (Scherer, 1984). The Componential Approach does not exclude the possibility that a combination of facial actions could form configurations that can be categorised as emotional expressions (Smith & Scott,

1997), or action tendencies. On the contrary, this view implies that the components involved in those configurations have some meaning that enriches the information conveyed by the overall pattern (*ibid.*).

In practice, the specific meaning and function of the individual components are not fully determined, but the evidence that simpler units of expression carries particular properties would certainly help understand the complexity of facial behaviour. Indeed, this approach allows separating the contributions of conversational, cognitive, and emotional aspects to complex facial patterns. For example, Ekman (1979) identified facial actions (mainly eyebrow movements) that appear to facilitate communication, to emphasise speech, and to regulate conversations. Similarly, a number of observers reported that raised eyebrows are often used to indicate a question, or are regularly integrated in greeting rituals (Darwin, 1872; Eibl-Eibesfeldt, 1972). Besides, Ekman (1985) noted that the typical expressions of anger, fear, and sadness include one or more muscular actions that most people cannot perform deliberately. He called these muscular movements the *reliable* muscles, in that they reliably indicate the presence of an emotion. Although it was not directly suggested by Paul Ekman, it is reasonable to propose that the *reliable* muscles represent the emotional components of facial behaviour. All in all, past research clearly show that facial behaviour is multi-dimensional, a property that might have evolved to deal with the complexity of human social relationships. The understanding of facial expressions will certainly progress when research will be able to specify and integrate the adaptive values of emotional and cognitive processes involved in social interactions.

3. Smiling and Laughter as Social Signals

Smiling and laughter are ubiquitous in human social interactions and received considerable attention from researchers worldwide. Yet the adaptive significance of these behaviours is still poorly understood. This shortcoming results mainly from the fact that only a few studies have investigated either the context or interactive consequences of smiling and laughter. An evolutionary informed study of smiling and

laughter construes these behaviours as social signals; parts of an evolved communication system designed by selection processes to solve problems related to sociality. These are the goals of the present thesis: to determine how smiling and laughter vary with different aspects of the social context, and also to investigate the social consequences of these behaviours. Ultimately, the management of social relationships can have positive consequences on an individual's reproductive success (Dunbar, 1998; Barrett *et al.*, 2002), and can therefore lead to the proliferation of genes underlying the behaviours that served to implement the successful social strategies.

3.1. Smiling

The smile is a universal behaviour present in all cultures and virtually all individuals the world over (Ekman & Friesen, 1971; Eibl-Eibesfeldt, 1989). It is also one of the most common and easily recognized facial display of our species. Nonetheless, as the novelist Herman Melville (1949) pointed out, a smile can be the vehicle of all ambiguities. This probably results from the fact that smiles usually take different forms (Brannigan & Humphries, 1972; Ekman & Friesen, 1982) and are displayed in a large variety of contexts (van Hooff, 1972; Henley, 1977; Goldenthal *et al.*, 1981). The main conclusion of early research is that smiling appears to be, above all, the expression of something positive such as emotions (Ekman & Friesen, 1982), intentions (Fridlund, 1994), or cognitive experience (Scherer, 1992). The present study is an attempt to see whether an evolutionary approach can go further and specify a possible function for smiling. The previous sections (animal signalling, non-verbal and facial behaviour) constitute the theoretical background within which smiling will be investigated. A brief overview of the literature on smiling will introduce the major findings related to that ordinary, yet rather confusing behaviour.

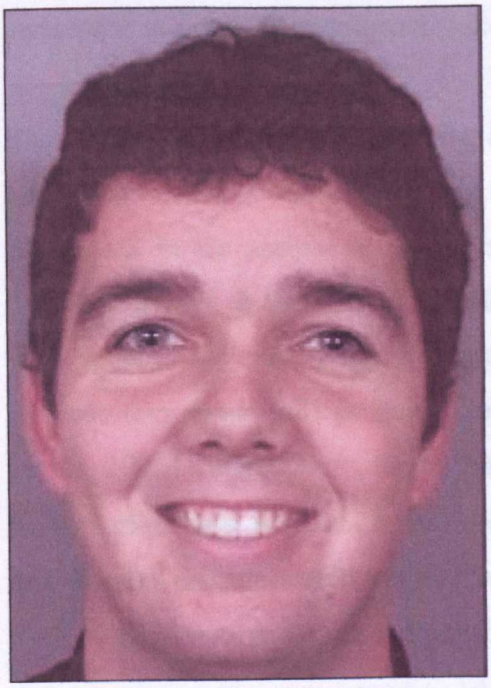
The smile appears very early in life and by the fifth week, starts to have its first social effects, including parental care and social attention (Wolff, 1963; Bowlby, 1969). From early on, smiling is a significant part of an individual's repertoire of social behaviour, because it quickly leads the baby's companions to respond to him/her in a playful and loving way. In their first face-to-face interactions, individuals engage in

smiling mainly when looking at their mothers (Weinberg & Tronick, 1994) but also when their mother is smiling (Kaye & Fogel, 1980). In fact, the human voice and face appear to be major stimuli that elicit smiling in babies (Ahrens, 1954). However, after a phase of unselective smiling during which individuals smile at any face-resembling object, babies start to become increasingly discriminating and only smile at familiar faces (Ambrose, 1961). Finally, what emerges is a period of 'differential social responsiveness' that generally lasts for the rest of an individual's life (Bowlby, 1969). During that phase, 'familiar faces are still smiled at freely, whereas strangers evoke reactions ranging from an anxious withdrawal to an almost self-consciously sociable smile' (Bowlby, 1969, p.281).

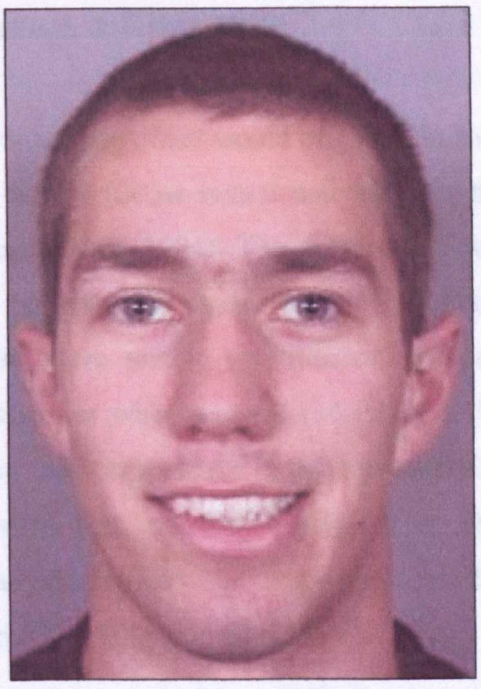
In early childhood, smiling is part of a larger set of interrelated behaviours involved in social interactions other than rough-and-tumble play or aggression (Blurton-Jones, 1972). This set of behaviours includes actions such as *pointing*, *giving*, *receiving*, *talking* and *smiling*, actions that are more common in 4 than in 2 year-olds (*ibid.*). In a study on smiling in preschool children playing competitive games, Schneider and Josephs (1991) found that the social situation played a major role in the display of smiles. Children smiled more in interactive than in non-interactive episodes, and smiles were more frequent and more intense among losers than among winners. Therefore, the ontogeny of smiling appears to parallel the development of social interactions, and more precisely to reflect progresses made at the cognitive and emotional levels of interpersonal relationships.

Smiling is produced by the activation of the *zygomaticus major*, a facial muscle that emerges from the lower face cheek bones and connects to the corners of the mouth. The activation of this muscle pulls the lip corners towards the cheek bones in an oblique direction (Ekman, Friesen, & Hager, 2002), and results in the facial appearance that we commonly name 'smile'. Paul Ekman and Wallace Friesen (1982) catalogued three different types of smiles by using the Facial Action Coding System, a measurement system previously elaborated by themselves (Ekman & Friesen, 1978). They distinguished the 'felt', the 'false', and the 'miserable' smile. The 'felt' smile – also called the Duchenne smile (Duchenne, 1862) – is believed to be the spontaneous

expression of a positive emotion and is characterized by the activity of two facial muscles: the *zygomaticus major* and the *orbicularis oculi* (*pars laterali* and *pars medialis*) (see *Figure 1.1*). As opposed to the 'felt' smile, the 'false' smile is considered by Ekman as a deliberate attempt to communicate the experience of a positive feeling when it is actually not felt. Ekman and Friesen (1982) noticed that the activation of muscles around the eyes (*orbicularis oculi*) is usually absent in 'false' smiles, and therefore represents a way to differentiate 'felt' from 'false' smiles. 'False' and 'miserable' smiles are both under voluntary control but according to Ekman and Friesen (1982) 'miserable' smiles are not performed to communicate incorrect information about the internal state of the sender. Instead, when showing 'miserable' smiles people would acknowledge feeling miserable, with no intention to do anything about it. The authors also mention that a multitude of other categories may arise from the combinations of these smiles with other facial actions (*idib.*).



a) The Duchenne smile is a combination of two facial actions: cheek raiser (AU6) and lip corner puller (AU12).



b) The cheek raise is absent in non-Duchenne smiles. Courtesy of the Perception lab, Department of Psychology, University of St Andrews.

Figure 1.1. Duchenne and non-Duchenne smiles.

There is evidence that the Duchenne smile[2] is associated with the experience of positive emotions. Surakka and Hietanen (1997) found that the expression of Duchenne smiles was better at inducing contagion of genuine pleasure than the expression of forced smiles. Similarly, Ekman and colleagues (1990) showed that spontaneous smiles occurred more often during the presentation of a pleasant film than during the presentation of an unpleasant film. Moreover, Duchenne smiles were associated with subjective reports of positive emotions whereas it was not the case for other types of smiles. In another study, researchers of the same team found that people displayed spontaneous smiles when they were truly enjoying themselves rather than when they feigned enjoyment in order to conceal negative emotions (Ekman *et al.*, 1988). It is however worth mentioning that the display of Duchenne smiles does not exclusively reflect positive emotions but is also dependent on social factors, such as the outcome of past interactions between sender and receiver (Schneider & Josephs, 1991), the attention directed to others (Fernandez-Dols & Ruiz-Belda, 1997), and the awareness of others being present (Jakobs, Manstead, & Fisher, 1999).

It was proposed that smiles involving an emotional component would originate in sub-cortical brain areas while voluntary displays would follow neural activation in the cortex, i.e. in the peripheral region of the brain (Rinn, 1994). The presence of two neural pathways in the control of smiles was suggested by studies in which patients with specific lesions in the pyramidal system were unable to smile on purpose, whereas they could still produce spontaneous smiles when amused (Meihlke, 1973; Myers, 1976). Interestingly, the reverse impairment was reported in patients suffering from Parkinson's disease. Researchers observed that individuals affected by this neurological disorder could not produce spontaneous smiles when happy but were able to show deliberate smiles on request (Smith, Smith, & Ellgring, 1996).

Neuroscience has shown that humans have two neural systems for controlling smiles: one under voluntary control and the other under involuntary control (Gazzaniga & Smylie, 1990; Gazzaniga, Ivry, & Mangun, 1998). Gazzaniga and Smylie (1990)

[2] Because the terms 'felt', 'false', and 'miserable' smiles used by Ekman and Friesen (1982) are mainly functional, we will prefer the appellations Duchenne or spontaneous smiles, and forced or deliberate smiles.

found that the left side of the brain is involved in the control of voluntary smiles: the left hemisphere sends messages to the contralateral VII nucleus which in turn innervates the facial muscle of the right side of the face. At the same time, the left hemisphere sends inputs through the corpus callosum to the right hemisphere, which functions to stimulate the left side of the face. On the other hand, involuntary smiles are triggered by a different neural pathway involving both sides of the brain. Gazzaniga and colleagues (1998) showed that when a person experiences a positive emotion, both hemispheres send signals that travel directly through the midbrain to the brainstem nuclei where the facial nerves originate. Consequently, smiles would be controlled unilaterally or bilaterally according to the voluntary or involuntary nature of the smile, respectively. This usually results in spontaneous smiles being more symmetric than deliberate smiles.

The presence of hard-wired connections responsible for the control of human smiling suggests that this behaviour has deep roots in the evolutionary history of our species. In a comparative study of the facial displays of non-human primates, van Hooff (1967) proposed that the similarity between human smiling and the chimpanzee's *silent bared-teeth* display (*SBT*) reflects a phylogenetic relationship. The *SBT* display (also called the fear grimace) is characterised by 'fully retracted mouth corners and lips, so that an appreciable part of the gums is bared; closed or only slightly open mouth; absence of vocalisation; inhibited body movement and eyes that are widely or normally open and directed straight or obliquely towards an interacting partner' (van Hooff, 1972, pp. 212-213). Although Redican (1982) claimed that the non-human primate grimace and the smile are morphologically distinct sets of action, a recent anatomical study conducted in chimpanzees confirmed the presence of a similar muscular basis between the human smile and the *SBT* (Burrows, Waller, Parr, & Bonar, 2006). Furthermore, the latter study strongly suggests that humans and chimpanzees share many aspects of facial musculature, reinforcing evolutionary hypotheses about the origins of facial expressions.

The *silent bared-teeth* display is not only present in chimpanzees but is also common to many non-human primate species (*Figure 1.2*). Generally, the *SBT* is shown by

subordinate individuals in tense social situations, and marks a transition to a more affiliative interaction. In some species however, the *SBT* is also displayed by dominant individuals as a sign of appeasement and reassurance (van Hooff, 1972; Preuschoft, 1992; Waller & Dunbar, 2005). The contextual variation observed in the *SBT* display most likely reflects a progressive broadening of the meaning of the element of baring the teeth (Andrew, 1963). Indeed, comparative analyses suggest that this element originated in a defensive or protective pattern of behaviour that gradually became, through a ritualisation process, a signal of submission, non-hostility, appeasement, and friendly reassurance (van Hooff, 1972; Fridlund, 1994). The latter aspect has prevailed as a result of particular selective pressures believed to be related to social organisation (Preuschoft & van Hooff, 1997). It is however plausible that the co-evolution between facial musculature and cognitive abilities have led to the persistence of multiple forms of smiling for which the interpretation varies from one situation to the other.

a) Free-ranging bonnet macaques, Tamilnadu State, India. Picture taken by the author.

b) Common chimpanzee at the Chester Zoo. Picture by Bridget Waller.

Figure 1.2. Silent bared-teeth display in (a) the bonnet macaque (*Macaca radiata*) and (b) the common chimpanzee (*Pan troglodytes*).

The universality of smiling, its early emergence in the repertoire of social behaviour, its hard-wired neurobiological connections, and its evolutionary origins within the primate lineage all suggest that it has a functional role in the social life of individuals. The ethologist Robert Hinde (1975) noted that the first indication of function often

comes from contextual information. Interestingly, psychological research provided evidence that smiling mainly occurs in social rather than solitary contexts. For example, in a field study conducted in bowling alleys, Kraut and Johnston (1979) showed that people were unlikely to smile when they had just hit a strike or a spare, but were more likely to do so when they turned around to face the other players. Similar results emerged from a study involving manipulation of sociality (Fridlund, 1991b), in which participants were watching a videotape in four different conditions: (a) alone; (b) alone, but with the belief that a friend was nearby performing an irrelevant task; (c) alone, but with the belief that a friend was watching the same tape in another room nearby; and (d) when a friend was physically present. Results showed that smiling significantly increased with the sociality of the situation, even though reported happiness did not differ between viewing conditions. Finally, researchers examining facial expressions of gold medallists during an award ceremony showed that, despite the intense emotional experience present throughout the ceremony, gold medal winners would only smile when interacting with the Olympic authorities or the public (Fernandez-Dols & Ruiz-Belda, 1995a). These studies clearly showed that the main context of smiling is social interaction.

In ethology, the term 'function' is usually applied to consequences that directly or indirectly increase an individual's reproductive success (Hinde, 1975). Hence, smiling will be said to have an adaptive function if it regularly triggers a chain of consequences that is relatively invariable and ultimately leads to reproductive advantages. Although the reproductive outcome of a behaviour might be difficult to assess, one of the first consequences of smiling is an automatic reaction in the receiver, passing through the activation of specific brain areas (Morris *et al.*, 1996; O'Doherty *et al.*, 2002), to that of facial musculature (Dimberg, 1988). Furthermore, smiling has been linked to a variety of positive social consequences, including parental care (Ambrose, 1961), a greater leniency from judges after committing minor offences (Forgas, 1987; LaFrance & Hecht, 1995), and monetary benefits (Tidd & Lockard, 1978, Brown & Moore, 2002). These studies therefore suggest that smiling regularly leads to favourable treatment from others. On the whole, if smiling mainly occurs within a social context

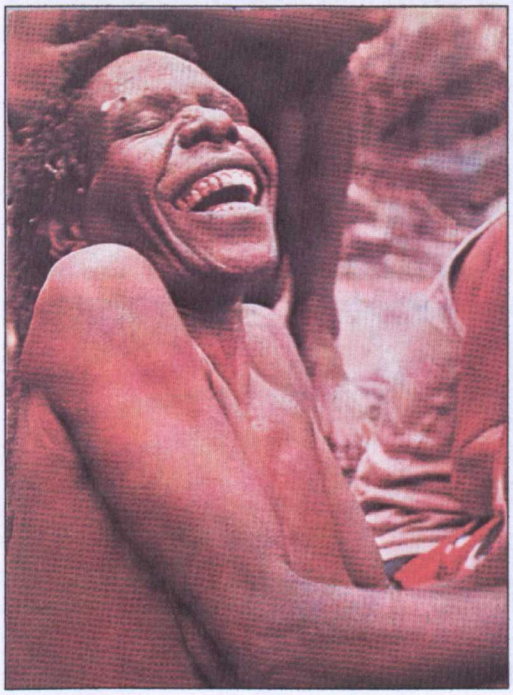
and leads to advantageous social consequences, it is likely that this behaviour is primarily involved in the regulation of social relationships.

Despite the fact that smiling is intrinsically social, very little is known about the way it is displayed in naturally occurring interactions. In fact, various aspects of sociality such as group size and group composition in terms of age and sex might possibly influence the way and frequency at which people smile to each other. Furthermore, if smiling is meant to regulate social interactions, it should also be related to conversational patterns, body contacts, and emotional arousal. As far as theory can help us generate testable predictions about the impact of these social aspects on smiling, the detection of a relationship between smiling and any of these factors would be valuable for the understanding of its function.

3.2. Laughter

Laughter is also a behaviour observed in all cultures (Apte, 1985; Provine, 2000; see also *Figure 1.3*) and has always been considered as a specifically human attribute (Koestler, 1949; Plessner, 1950). Although the releasing factors (e.g. humour) rather than the behaviour itself have received most attention in the literature, a few studies indicate that laughter may well function as a signal that promotes social cohesion (Provine, 2000; Gervais & Wilson, 2005). The distinction between humour and laughter is important because these two entities are intrinsically different. Whereas humour is the cultural manifestation of a psychological phenomenon, and therefore requires analysis at a specific level; laughter is an evolved behavioural response that occurs in a wide range of social circumstances, including humorous ones. To make an analogy, the difference between humour and laughter can be illustrated by the difference that exists between cuisine and eating. Cuisine represents the cultural development relative to food processing and this activity is specifically targeted at eating. The fact that cuisine makes the eating experience particularly agreeable does not necessarily imply that cuisine is essential to eating. There is no need to argue that eating can be performed in the absence of cuisine. Similarly, laughter is often observed in situations that are not particularly amusing for an external observer (Provine, 1993).

Humour is to laughter what cuisine is to eating, that is, a cultural elaboration of the stimuli that naturally lead to perform the behaviour. The present research will concentrate on the behaviour itself rather than on the eliciting circumstances of laughter.

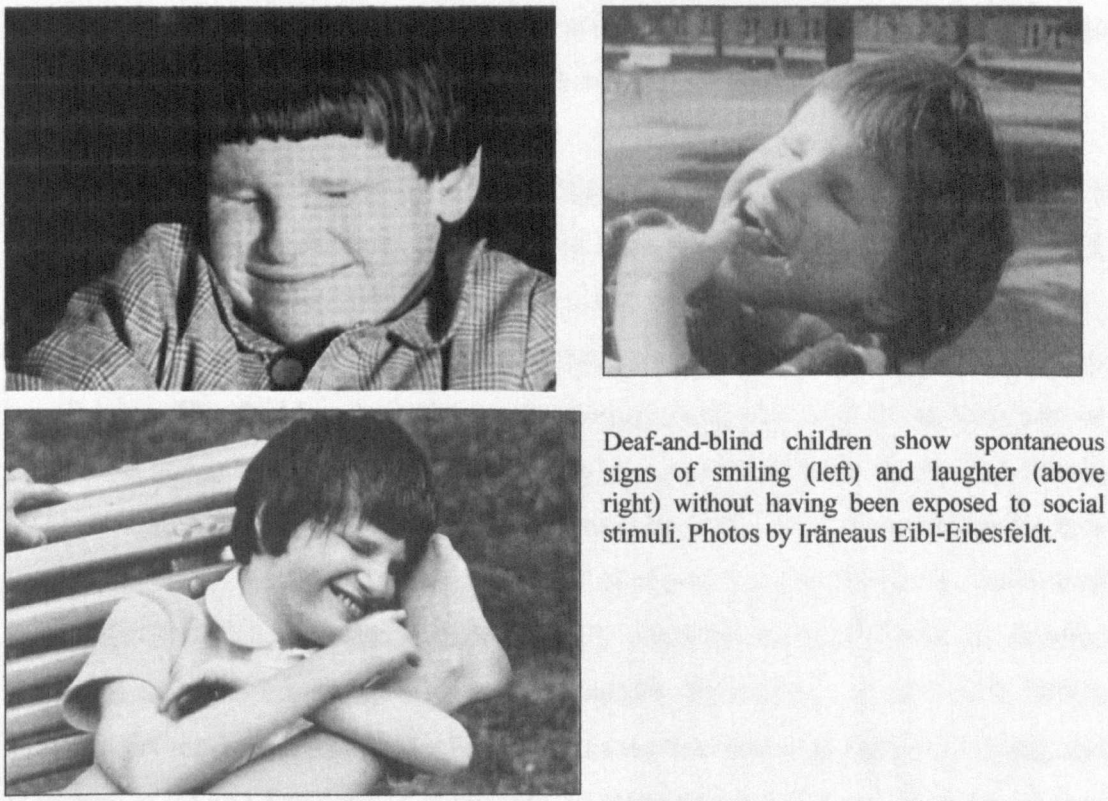


Laughter can be observed in many cultures. On the left, a Papua New Guinea Highlander (photo by Bill Leimbach), above an Iraki milkman (photo by Jan Oberg)

Figure 1.3. Human laughter in two different cultures

Laughter usually makes its first appearance between two and six months of age (Sroufe & Waters, 1976; McGhee, 1979; Fogel *et al.*, 1997) and is one of the first social vocalisations emitted by human infants (Deacon, 1997). Although this onset might be considered too late so to qualify laughter as innate, many traits and aspects of behaviour are 'programmed' to appear well after birth (Lorenz, 1978). In addition, a strong argument in favour of the innateness of laughter comes from the observation that deaf and blind children exhibit the behaviour despite not having perceived or learned it from others (Eibl-Eibesfeldt, 1989, *Figure 1.4*). Within the first two years of life, laughter is regularly observed in mother-infant interactions and is believed to regulate early playful encounters (Fogel *et al.*, 1997). Later on, laughter is one of the main behavioural components expressed in rough and tumble play, a category that is negatively correlated with the occurrence of aggression (Blurton Jones, 1972). As in

the case of smiling, laughter seems to be part of the behavioural 'equipment' provided by nature to navigate in the social environment.



Deaf-and-blind children show spontaneous signs of smiling (left) and laughter (above right) without having been exposed to social stimuli. Photos by Iräneaus Eibl-Eibesfeldt.

Figure 1.4. Smiling and laughter in a deaf-and-blind child

Laughter is one of the most typical human vocalisation and involves a stereotyped exhalation of air outside the mouth cavity, as well as head and body movements. The simple structure of laughter is characterised by one or more heartily voiced, acoustically symmetric, vowel-like notes (ha-ha-ha) (Provine & Young, 1991; Bachorowski, Smoski, & Owren, 2001). Laugh notes are generally spaced by intervals of regular duration and disappear in a decrescendo. Moreover, these notes have a strong harmonic structure, with females having higher-pitched average fundamental frequencies than males (Provine & Young, 1991). Nevertheless, this conventional definition of laughter is complicated by a fair variation in the types of behaviours that would be generally classified as laughter. For instance, a distinction can be made between voiced and unvoiced laughs (Grammer & Eibl-Eibesfeldt, 1990; Bachorowski & Owren, 2001). The first category is characterised by the earlier described "song-like" structure and is mainly composed of voiced sounds, whereas the second category

includes outputs ranging from unvoiced calls with a salient nasal-cavity turbulence to acoustically noisy unvoiced sounds arising in either the laryngeal or oral cavities (Bachorowski *et al.*, 2001). Laughter can also vary in intensity on a continuum between discrete recurring chuckles to loud and hearty laughter. It is interesting to note that these distinctions probably have a functional significance in social relationships.

Laughter is believed to have evolved from the *relaxed open-mouth* display (*ROM*), or play face, displayed by non-human primates during friendly encounters (van Hooff, 1972; Waller & Dunbar, 2005, see also *Figure 1.5*). The play face includes a widely opened mouth and rapid staccato breathing that in some species develops into bursts of vocalisation. The *ROM* exclusively appears during social play, and informs the partner that co-occurring actions are playful and not dangerous (Bateson, 1969; van Hooff, 1972; Waller & Dunbar, 2005). In that sense, the *ROM* is a meta-communicative display. Interestingly, a variant of the *ROM* is the *relaxed open-mouth bared-teeth* display (*ROMBT*), also called "laughter-face", which is characterised by an extreme baring of the teeth combined with an open mouth (Preuschoft & van Hooff, 1997). This display represents an intermediate between the two ancestral forms of smiling and laughter (*ROM* and *SBT*) and is found only in some species of apes, where it seems to complement and replace relaxed open-mouth, while taking over the typical staccato breathing vocalisation. The *relaxed open-mouth bared-teeth* display thus bears striking resemblance with human laughter (Preuschoft & van Hooff, 1997).

Photo by Jan van Hooff

Photo by Bridget Waller

Figure 1.5. Relaxed open-mouth display in the common chimanzee (*Pan troglodytes*)

The regular occurrence of *ROM* and *SBT* in a variety of remotely related primate species suggests that these behaviours are ancestral features and can be regarded as homologous in all the species (Preuschoft & van Hooff, 1997). Ethological studies pointed out that these behaviours occur in a variety of situational contexts, indicating a wide range of motivational backgrounds and social functions. Still, the remarkable overlap between these displays led researchers to conclude that they converged during the course of evolution as a result of their association with non-aggressive contexts (van Hooff, 1972; Preuschoft & van Hooff, 1997; Waller & Dunbar, 2005). This functional convergence between behaviours, which is also evident morphologically in the *relaxed open-mouth bared-teeth* display, has been put forward to account for the intricate connection between human smiling and laughter.

Laughter has been found in social contexts ninety-five percent of the time (Provine & Fischer, 1989). Conversations seem to be the main situations in which laughter is displayed, and because it occurrs immediately after complete sentences, laughter has been said to 'punctuate' speech (Provine, 1993). Another interesting finding was that speakers laugh more than their audience (Provine, 2000; Vettin & Todt, 2004), a fact that appeared to be pronounced when female speakers were conversing with a male audience (Provine, 1993). On the other hand, audience laughter seems to be highest when the speaker is a man (*ibid.*). In addition, laughter rate can be higher during interactions involving friends rather than strangers (Devereux & Ginsburg, 2001) and men seem particularly sensitive to that effect (Smoski & Bachorowski, 2003). Hence, the context of laughter is mainly social, and it affects individual behaviour differently according to sex.

Among the multiple consequences of laughter, this behaviour has been shown to enhance social relationships by inducing pleasurable experience through a simple contagion process (Provine, 1992). In addition, laughter appears to reward others' actions thus encouraging ongoing social activities (Weisfeld, 1993; Dunbar, 2004). Interestingly, people who frequently experience laughter or deal with humour report more intimate social relationships (Hampes, 1994), greater role satisfaction (Kuiper *et al.*, 1992) and reduced loneliness (Overholser, 1992). In a study investigating laughter

and smiling during bereavement, Keltner and Bonanno (1997) showed that Duchenne laughter (spontaneous smile associated with laughter-related vocalisation and open mouth) was related to increased recollection of relationship adjustments with the deceased spouse and with reduced ambivalence towards a current important person. Laughter also appeared to increase cohesiveness and cooperation in goal-oriented groups (Banning & Nelson, 1987; Vinton, 1989; Greatbatch & Clark, 2003). Overall, these studies indicate that through the improvement of interpersonal relationships, laughter has positive social benefits and could therefore be a central mediator of group cohesiveness.

Social contagion is one of the mechanisms through which laughter could produce an effect of cohesiveness. In fact, Robert Provine (1992) noticed that laughter itself was one of the most powerful trigger for laughter and therefore suggested that it could mediate the phenomenon of contagion. Provine (1996a) went on to propose that the contagious effect of laughter might result from the operation of a neurobiological mechanism specialised in the detection and in the generation of laughter. He suggested that humans have an 'auditory feature detector', a neurological detector that responds specifically to the sound of laughter. The 'feature detector' would, in turn, activate the neurological 'laugh generator' that creates the stereotyped movements of the thorax, larynx and vocal track that produce the sound of laughter. The particular brain areas responsible for this mechanism have, however, not been specified.

As for the means through which people are motivated to seek contexts that induce laughter, Robin Dunbar (1996a) proposed to look at the reward mechanism associated with this odd behaviour. He suggested that the production of endorphins resulting from intense laughter episodes would be responsible for seeking and maintaining social situations that involve laughter (mainly conversations), in the same way endorphin release is believed to provide the proximate means through which social grooming acts as a bonding mechanism in non-human primates (Keverne, Martensz, & Tuite, 1989). Within that framework, laughter would be a crucial aspect in the evolution of language as a bonding mechanism because it would provide a direct reinforcer responsible for the development of conversations (Dunbar, 1996a). If the installation of social

alliances has to pass by the common experience of positive emotions, laughter should therefore be a major player in the process of bonding.

The effect of laughter on emotion and social perception may account for a proximate explanation of why laughter could enhance social bonds. In this context, the distinction between 'voiced' and 'unvoiced' laughter seems crucial, as these variants appear to produce different effects in listeners. Voiced laughter is considered to be "song-like" and is comprised of vowel-like sounds whereas unvoiced laughter resembles breathy pants and consists of noisy non vocalised exhaustion of air arising in either the nasal, laryngeal, or oral cavities (Grammer & Eibl-Eibesfeldt, 1990; Bachorowski, Smoski, & Owren, 2001). Grammer and Eibl-Eibesfeldt (1990) reported that when men where paired with women for a short interaction, male interest in the female was correlated to the amount of voiced, but not unvoiced laughter she produced. Bachorowski and Owren (2001) examined the issue of voicing in more details and found that vocalised laughs were rated more positively than unvocalised ones, with the effect being larger for females' laughs. Interestingly, the results were rather consistent between ratings, regardless of whether the judgements were performed on the laugher or on the laughter episode itself.

Following these research, Owren and Bachorowski (2003) concluded that non-linguistic vocalisations could function to modify the internal state of receivers. The induction of positive affect in the listener would influence his/her subsequent behaviour and produce a favourable stance toward the laugher. Similarly, Keltner and Bonnano (1997) had found that the modification of the internal state occurring during laughter had a significant impact on how people perceived each other. Taken together, these facts suggest that laughter can have positive social consequences for the sender. Furthermore, the observation that certain forms of laughter are more effective than others in producing positive responses might reflect an evolutionary arms race between the tendency to produce efficient signalling and the inclination to evolve a resistance to sensory exploitation.

If laughter is a social signal that is meant to promote bonding between individuals, little is known about the kind of interactions that laughter is supposed to regulate. For example it could be used in courtship to favour pair bonding between potential sexual partners, or it could be helpful to cement intra-sexual relationships. In addition, laughter could be used by subordinate individuals in order to appease dominant people in hierarchical situations. The present state of knowledge regarding laughter makes these assumptions equally possible. The observation of laughter in natural settings that vary according to different aspects of group size and composition might bring some light on the role of this behaviour in social relationships.

4. Rationale and goals

The present research is an attempt to assess the function of smiling and laughter by considering these behaviours as evolved social signals involved in human communication. In short, smiling and laughter would represent attempts to advertise socially advantageous characteristics, and would therefore determine the modalities of social interactions. Through these behaviours, people would drive social encounters in a direction that ultimately benefit themselves. The approach used here is derived from ethological studies and evolutionary theory and is distinct from most accounts on facial expressions, as the central theme here is communication rather than emotion. The long-lasting focus on emotional expression delayed the investigation of crucial aspects of social behaviour, i.e. the way it is expressed in natural situations and its interactive consequences.

The thesis is divided in two parts that include two chapters each. The first part is concerned with the display of smiling and laughter in naturally occurring social interactions. Particular attention will be paid to the influence of group size, age, and sex on the frequency of different forms of smiling and laughter (second chapter). Then, the relationship between these behaviours and other social behaviours such as conversation and body contacts will be investigated (third chapter). The second part of the thesis will consist of experimental work on the perception of smiling, and on the

influence of context on different forms of smiling and laughter. The fourth chapter will examine the impact of smiling on the perception of individual traits believed to be adaptive for the development of social relationships. The analysis will concentrate on sex differences in the effect of smiling on person perception. That chapter will also include an analysis of the effect of smile type on the judgement of individual traits. The fifth chapter will look at the display of different types of smiling and laughter in the context of bargaining between friends. Moreover, that section will examine the impact of personality, friendship, altruism, and self-reported emotion on the performance of smiling and laughter. Finally, the general discussion will articulate these findings in light of the current knowledge and show what can be learnt about the function of smiling and laughter.

Chapter Two

SMILING AND LAUGHTER IN NATURALLY OCCURRING GROUP INTERACTIONS: A TEST OF HYPOTHESES

1. Introduction

Past research showed that smiling and laughter are undeniably social. First because their frequency of occurrence increases in social as opposed to solitary contexts (Mackey, 1976; Kraut & Johnson, 1979; Fridlund, 1991; Provine, 2000), and second because they have been linked to interactive consequences such as parental care (Ambrose, 1961), a greater leniency from judges after committing minor offences (Forgas, 1987; LaFrance & Hecht, 1995), monetary benefits (Tidd & Lockard, 1978, Brown & Moore, 2002), and positive social judgements (Bachorowski & Owren, 2001). Therefore, it is likely that laughter and smiling serve a social function, and are integral parts of a signalling system that evolved to communicate a variety of information (Eibl-Eibesfeldt, 1989; Fridlund, 1999). The ethological approach to human behaviour invites us to examine the adaptive nature of non-verbal signals through the analysis of (1) the ecological context in which they occur, and of (2) their fitness consequences (Hinde, 1975). This chapter mainly investigates the social context in which smiling and laughter are displayed by humans.

If smiling and laughter have a functional role in the social world, they should ultimately boost people's reproductive success through a better management of their social relationships. Three different social arenas were identified as relevant to the function of social behaviour because they are directly or indirectly related to reproductive success: mate choice, social competition, and cooperation. Using these three facets of social relationships as three different hypotheses, predictions were derived in order to determine which aspects of the social context should be expected to have the most impact on the frequency of smiling and laughter.

1.1. The Mate Choice Hypothesis

As a result of being directly relevant to reproduction (Darwin, 1871), mate choice is the first social sphere to consider. In that respect, smiling and laughter could be used either to advertise some aspects of mate quality or to acknowledge the choice of an individual as a valuable mating partner. This hypothesis found support in a field study conducted in bars, in which smiling was found to be a recurrent display within the female courtship behavioural repertoire (Moore, 1985; Moore & Butler, 1989). Furthermore, smiling faces have been repeatedly rated as being more physically attractive than neutral ones (Lau, 1982; Reis *et al.*, 1990; Otta *et al.*, 1994, 1996). More recently, neurobiological research showed that the rewarding value of an attractive face can be increased by the presence of a smile (O'Doherty *et al.*, 2003).

As for the possible role of laughter in mating context, it was found that female's interest in the male could be predicted by the number of times she joined the male in laughing, and by the number of instances she laughed (Grammer & Eibl-Eibesfeldt, 1990), supporting the assumption that laughter could be, at least for females, a signal of interest in a potential partner. In a different study, higher sexiness ratings were attributed to female voiced laughs by male listeners than by female listeners (Bachorowski & Owren, 2001). Therefore, these studies show that smiling and laughter could act as social signals in courtship situations.

Predictions of the Mate Choice Hypothesis

A key prediction of the mate choice hypothesis is that smiling and laughter should vary with the **sex composition of groups**: *display rates should be higher in mixed-sex groups as opposed to same-sex groups*. Besides, within mixed-sex groups smiling and laughter should be *primarily **directed to** opposite-sex individuals*. The effect due to the presence of opposite-sex individuals should be particularly strong for female laughter, as interactions with males have been shown to significantly affect the frequency of women's laughs, at least in dyads (Grammer & Eibel-Eibesfeldt, 1990; Provine, 2000; Smoski & Bachorowski, 2003).

The frequency of public smiling has been reported to decrease with **age** (Chapell, 1997). However, the effect of **age** on courtship displays should differ according to sex. Because female's reproductive potential decreases as they grow older (Fischer, 1930; Pennington & Harpending, 1993), and because there is a net advantage to focus on courtship displays during the period when reproduction is most likely to occur (Miller, 2000), women smiling and laughter should vary with **age** and their frequency *should be higher in young than in mature women.* The effect of **age** on women's behaviour should be restricted to mating contexts, i.e. when women interact in mixed-sex groups. Given that **age** is less relevant to male's reproductive success, *men's smiling and laughter rates should be unrelated to their* ***age****.*

The mate choice hypothesis also predicts a **sex** difference in the amount of smiling and laughter that individuals should be expected to display if these behaviours were advertising mate quality. Nevertheless, the direction of this **sex** difference should depend on the roles of laughter and smiling in mate choice. If smiling and laughter are cues advertising physical attractiveness, *women should display more of these behaviours than men,* as a result of the former being more concerned with the advertisement of such cues (Buss, 1987; Grammer, 1989; Pawlowski & Dunbar, 2001). On the other hand, if smiling and laughter act as displays of status and commitment, one should expect *men to display more of those behaviours than women,* given that these attributes are favoured by women (*ibid.*). Note that these **sex** differences should be present in mating contexts only, i.e. when people interact in mixed-sex groups.

Still in the context of mate choice, the **age composition of groups** could have an impact on smiling and laughter rates, depending on the sex and age of individuals involved. Indeed there is evidence that men show preferences for younger women (as they have a higher reproductive potential than older women) whereas women tend to prefer mates who are older than themselves (Kenrick & Keefe, 1992; Pawlowski & Dunbar, 2001). Therefore within mixed-sex groups, *smiling and laughter rates displayed by mature men and young women should be higher in mixed-age than in same-age groups.*

In the context of mate quality advertisement, **group size** *per se* should not have an effect on smiling and laughter. Instead, the frequency of these behaviours should *increase with the number of opposite-sex partners*, as one should expect courtship displays to be more frequent when there are more mating opportunities. Similarly, *female's smiling and laughter should be positively related to the* ***sex ratio*** *(proportion of males), whereas male's affiliative behaviours should be negatively related to the* ***sex ratio***.

1.2. The Competition Hypothesis

Social competition is another domain that is particularly relevant to fitness (Darwin, 1871). The second hypothesis relies on the assumption that smiling and laughter could regulate hierarchical relationships and help avoid the risks resulting from agonistic interactions. In fact, hierarchies in primates are believed to govern social relationships through the establishement of a system preventing the escalation of inter-individual conflicts into damaging consequences (de Waal, 1986; Dunbar, 1988). Non-human primate literature suggests that some aspects of social behaviour could function to implement this system in day-to-day social interactions (de Waal & Luttrell, 1985; Thierry *et al.*, 1989). For example, in some macaque species the *silent bared-teeth* display, homologous to the human smile, would function to advertise a submissive position in the hierarchy (de Waal & Luttrell, 1985, Preuschoft, 1992). In other species however, the meaning of this behaviour seem to have broadened, as it is generally observed in a larger variety of contexts, including appeasement, reconciliation, affiliation, and reassurance (van Hooff, 1972; Lockard *et al.*, 1977; Preuschoft, 1992; Waller & Dunbar, 2005).

Nonetheless, the emancipation of the display over the course of evolution does not exclude that it is still used in its context of origin, in particular when the selection pressures responsible for its early evolution still persist. The evolutionary significance of social hierarchy in humans have been largely documented (Mealey, 1985, Müller & Mazur, 1998) and psychological research suggest that smiling might still be part of dominance relationships. For example, while studying competitive interactions in

children, Schneider and Josephs (1991) found that losers were smiling more frequently and more intensely than winners. In addition, non-smiling people are usually perceived as dominant (Keating *et al.*, 1977, 1981). Finally, Mast and Hall (2004) found that among women occupying subordinate positions, those who felt more comfortable assuming a subordinate role smiled more than those who preferred being in a dominant position. Smiling could also be important in social competition because it alleviates tension (Goldenthal *et al.*, 1981). Given that smiling and laughter have postive effects on receivers (Lanzetta & Orr, 1986; Doherty, 1998, Bachorowski & Owren, 2001), these behaviours could be considered as attempts from subordinate individuals to appease dominants and thereby avoid the damaging consequences resulting from open conflicts.

Predictions of the Competition Hypothesis

In the context of social competition, **age** could affect female smiling and laughter for the same reason as it could in a mate choice context, with the exception that this effect should not depend on the sex composition of groups. Therefore, if young females are more likely to engage in social competition than old females (Campbell, 2002), ***age should be negatively related to smiling and laughter rates in women.*** Note that competition is most likely to occur in women during reproductive age (Campbell, 2002), and should therefore decrease in the early thirties. Predictions are slightly different for the effect of **age** on male's laughter and smiling. **Age** being generally related to professional situation and therefore to social standing, it will be used here as an indicator of status. By virtue of the salary scale, mature individuals (approximately over 35 years old) usually enjoy higher social positions than younger ones. Consequently, if laughter and smiling act as attempts to appease dominant individuals in hierarchical contexts, *young men should laugh and smile more than mature men when observed in mixed-age groups*. This **age** difference should be absent when men interact in same-age groups.

Cashdan (1998) noticed that men smile less than women in tense situations, a finding that could be explained by a combination of two interesting facts: dominance is a central dimension of male relationships (Betzig, 1986; Barrett *et al.*, 2002), and non-

smiling faces are perceived as being dominant (Keating *et al.*, 1977, 1981). In addition, past research reported that men display more non-verbal indicators of dominance than women when interacting in mixed-sex groups (Aries, 1982). Therefore, if men try to avoid being perceived as submissive there should be a **sex** difference in smiling, *with men smiling less often than women.* Moreover, the fact that women have a tendency to avoid direct confrontation (Campbell, 2002) further validates the possibility of a **sex** difference in smiling in the predicted direction. Finally, there is *no particular reason to expect a **sex** difference in laughter rates* under the competition hypothesis.

If smiling functions to regulate hierarchical relationships, as suggested by the phylogenetic origins of the display (van Hooff, 1972), this behaviour should be prevalent in situations where status differentials are high. In the context of the present study, age is used as an indicator of status, hence the **age composition of groups** should have an impact on smiling rates, *which should be higher in mixed-age than in same-age groups.* The effect of **age composition of groups** could be similar on laughter than on smiling, as it has been suggested that laughter can be used to 'break the ice' in formal and hierarchical contexts (van Hooff, 1972). For smiling, but not necessarily laughter, *the difference due to **age composition** of groups should be more important in young individuals*, given that smiling could be used by people who occupy a lower position in the hierarchy in order to appease dominant individuals.

The competition hypothesis also entails that people compete with individuals of their own sex in order to gain access to opposite-sex partners (Darwin, 1871). The frequency of smiling and laughter should therefore be *higher in mixed-sex than in same-sex groups*, as the presence of opposite-sex individuals will exacerbate competition within a sex class. Yet *this trend should be absent in men smiling* by virtue of the fact that showing 'submissive' cues could undermine their efforts to gain access to mates.

Because more competition is expected in larger groups, smiling and laughter rates *should increase in line with **group size***, and *this effect should be particularly strong in mixed-sex groups.* Moreover, in mixed-sex groups, smiling and laughter rates should

increase with the proportion of same-sex individuals, as competition for opposite-sex partners will be higher when the number of potential competitors is high. Therefore *women's smiling and laughter should be negatively related to the* ***sex ratio*** *while men's laughter (not smiling) should be positively related to the* ***sex ratio***. Finally, in mixed-sex groups, *smiling and laughter should be mainly* ***directed to*** *same-sex individuals.*

1.3. The Cooperation Hypothesis

Cooperation is another social sphere in which smiling and laughter could be adaptive. Indeed, social interactions are not always competitive but can also lead to balanced relationships in which all the parties involved obtain some benefits. Repeated interactions between unrelated individuals are a persistent feature of human groups (Dunbar, 1996a; Hinde, 1997) and represent the ground on which reciprocal altruism can evolve (Trivers, 1971). However, investing resources in a cooperative alliance might be risky if people are not sure of their partner's commitment to a balanced relationship. Constant failure to reciprocate often leads to social exploitation, a situation that is also known as the free-rider issue (Dunbar, 1999; Barrett *et al.*, 2002).

Although cheat-detection has received attention as the main adaptation to the selective pressure imposed by free-riding (Cosmides, 1989; Cosmides & Tooby, 1992; Dunbar, 1999), altruist-detection has been put forward as an equally good solution to that problem (Brown & Moore, 2000). There is evidence that smiling could act as a signal facilitating the identification of cooperative partners (Scharlemann *et al.*, 2001; Brown & Moore, 2002; Brown *et al.*, 2003). In particular, the sharing of positive emotions through Duchenne smiling has been proposed to be a major solution to resolve commitment problems (Brown & Moore, 2002; Brown *et al.*, 2003). This last point will be detailed in *chapters 4* and *5*, when the connection between smiling and altruism will be investigated. Suffice to say now that smiling could be used to implement a social strategy based on cooperation.

If social living is founded on cooperation, a certain degree of group cohesiveness must be achieved to ensure significant reproductive benefits for each of its members (Barrett *et al.*, 2002). Language has been proposed to act as a mechanism that promotes group cohesiveness, and in that context, laughter would provide the proximate reinforcer that helps conversations achieve their social function (Dunbar, 1996a). This proposal found support in studies showing that laughter mainly occurs during conversations (Provine, 2000), and generally improves cohesiveness and cooperation in goal-oriented groups (Banning, 1987; Vinton, 1989; Greatbatch & Clark, 2003). Smiling and laughter could therefore be used to establish and foster cooperative alliances that would lead to a better exploitation of resources, and ultimately to increased reproductive success.

Cooperative relationships are certainly more valuable when they are stable and run over a long time. In classic models of reciprocal altruism (e.g. Axelrod, 1984) the probability that a relationship between two individuals will continue has a strong impact on the likelihood that the cooperative strategies will do well. Although human friendships are far from being governed by Tit-for-Tat reciprocity (Argyle & Henderson, 1984; O'Connor, 1992), friendships are seen as long term alliances that involve emotional support, commitment, and balanced relations between individuals (Hinde, 1997; Buunk & Schaufeli, 1999). Moreover, such alliances are believed to be more fertile when they involve people who are somehow similar to each other (Zeggelink, 1995). In their analysis of social networks, Dunbar and Spoors (1995) showed that women had a significantly larger number of female friends in their networks than men, whereas men had more male friends. If having the same sex is important in building friendship, then age similarity could also motivate the development of a cooperative bond. Indeed, age similarity would balance the prospective period during which altruistic acts can be reciprocated, but it would also ensure that what is invested in the relationship is of comparable value to the other person. In other words, the fact that cooperative partners are at the same life stage could be important to guarantee a long-term balance in needs and priorities.

Predictions of the Cooperation Hypothesis

There is evidence for major **age** differences in the structure of social networks (Hansen, 1986; Platz 1989). Young people have generally more social contacts than older ones, and contacts developed by young individuals mainly involve peers, whereas older individuals' relations cover children, friends and formal acquaintances (Due *et al.*, 1999). Although this suggests that the formation of alliances might be particularly important for young people, the effect of **age** on social relationships should depend on the sex of individuals. Indeed, mature men have been shown to give equal importance to their friends and their family, while women's relationships in later years seem to involve more contacts with children (Due *et al.*, 1999). Consequently, if smiling and laughter are crucial to the development of cooperative relationships, *their frequency of occurrence should be higher in younger women than in mature women.* On the other hand, because both men and women can benefit from cooperative relationships there is *no particular reason to expect* ***sex*** *differences in smiling and laughter* rates if these are involved in coalition formation.

It was mentioned earlier in this section that cooperation could be more fruitful when it involves individuals who are similar to each other, for example in terms of age and sex. Therefore *smiling and laughter rates should be higher in same-age groups than in mixed-age groups*. If smiling and laughter are important for cooperation within a given sex class, then we might expect their frequency of occurrence to be *higher in same-sex groups than in mixed-sex groups*. In that respect, we could observe a different effect of **sex composition of groups** on women's behaviour. Indeed one of the reasons proposed to explain coalition formation between females is the protection from male aggression (Campbell, 2002). Because the presence of men might also stimulate alliances between females, *women smiling and laughter should not necessarily be affected by the* ***sex composition of groups***. In addition, *women's affiliative behaviours could be positively related to the number of men.*

The more people interact together the more opportunities there are to form alliances. However, large **group sizes** also mean increased risks of social exploitation by free-

riders (Dunbar, 1999). If smiling advertises altruistic dispositions, people should avoid disclosing such traits in situations where free-riders are likely to be present, i.e. in larger groups. On the other hand, some authors claim that there should be social advantages to be viewed as an altruist by the population at large (Alexander, 1979; Zahavi & Zahavi, 1997; Roberts, 1998). In other words the reputation of being an altruist in a wide population can be beneficial because it increases the chance that unrelated individuals will be willing to engage in a cooperative alliance (*ibid.*, see also Noë & Hammerstein, 1995). Therefore, *smiling should be related to* ***group size*** *either negatively or positively.* Finally, if laughter promotes group cohesion, *one should expect it to be positively related to* ***group size***, as larger groupings might require a higher level of cohesiveness than smaller parties.

The relationship between **group size** and affiliative behaviours like laughter and smiling could depend on the sex of individuals. Dunbar and Spoors (1995) indeed showed that women have larger social networks than men and this could be evidence that women are able to manage a larger number of relationships than men. In addition, men and women tend to have more people of their own sex in their social networks (Dunbar & Spoors, 1995). Therefore, if smiling and laughter are involved in the management of cooperative relationships, *women's behaviours should increase in line with the number of other women, whereas men's smiling and laughter should be positively related to the proportion (and eventually the number) of men present in the group.* Finally, in mixed-sex groups *affiliative behaviours should be primarily* ***directed to*** *same-sex individuals.*

2. Method

2.1. Subjects

In total, 212 humans were sampled. People's age was roughly estimated by the observation of physical appearance, and they were classified into four categories: adolescent: less than 20 years old; young adult: 20-35 years old; middle age adult: 35-65 years old; and old adult: more than 65 years old. The composition of groups in terms of age and sex was also taken into account. Mixed-sex groups included both males and females, whereas same-sex groups included only males or females. Mixed-age groups included individuals of different age classes while same-age groups were composed of people from the same age class. Most individuals were white Caucasians, though the sample also includes a few middle-eastern and black individuals. Due to restrictions imposed by anonymity, no systematic examination was made of background variables.

2.2. Procedure

Observations were conducted in Liverpool city centre, in two types of environments: bars and food courts. People were covertly observed from a distance of 5-20m. Individuals were selected if their face was accessible to the observer and if they were interacting in a stable social group. Interactions with passers-by were not recorded. Data were collected from June to November 2003 over a seven day week. Days were divided in three periods: morning (9-12am) – afternoon (12am-6pm) – evening (6pm-10pm). All occurrences of the behaviours described below were sampled during focal observations performed on one individual at a time (Altmann, 1974). The duration of samples varied from 15 to 30 minutes, according to the time that individuals spent in the place. The average duration of a sample was 22.7 min (Std. Dev= 5.93). Data covered a total of 80.36 hours of observation.

2.3. Behaviours

Smiles were classified in two types: spontaneous and forced. The spontaneous smile was similar to the Duchenne smile described by Ekman and Friesen (1982), i.e. it had to be symmetric and to entail facial activity in the eye region. The forced smile category included all other types of smiles: false or miserable smiles (Ekman & Friesen, 1982), and the smiles on which an obvious voluntary control was imposed. The voluntary nature of smiles was inferred using two criteria: symmetry and timing. Asymmetric smiles and smiles with abrupt onsets and offsets were considered as being forced.

Laughter was categorised along two dimensions: type and intensity. The two types were: spontaneous and forced laughter (Keltner & Bonnano, 1997). The spontaneous laugh was merely an event of laughter accompanied by a spontaneous smile whereas a forced laugh was obviously deliberate and did not include spontaneous smiling. In addition to these two types, there were three levels of intensity: low – medium – high. The intensity was assessed by the inclusion of four components typical of laughter: staccato breathing, vocalisation, open-mouth, and body movement (mainly head, shoulders and trunk). The presence or absence of these factors determined the intensity of laughter as follows:

- Low intensity: brief exhalations with limited vocalisation (up to three notes), mouth slightly open or closed, rhythmic shoulder movements, and the trunk slightly tilted forward or backward.
- Medium intensity: prolonged vocalisation (more than three notes), open-mouth, same body movement as low intensity but rhythmically more pronounced.
- High intensity: loud and prolonged vocalisation, open-mouth, head and trunk goes abruptly backward (sometimes forward).

The number of males and females taking part in the interaction was also specified, and the direction of behaviours was recorded whenever it could be determined. For smiling, the head orientation and gaze direction were used to determine which

individual of the group was targeted by the sender. Because of the head movements that result from laughter, head orientation was difficult to use as a cue for direction. Laughter direction was therefore determined solely with gaze orientation observed at the beginning and at the end of the display.

2.4. Data Analysis

Frequencies of smiling and laughter were transformed into a rate per minute. These rates were transformed using the square root function whenever they did not follow the normal distribution (confirmed by Kruskal-Wallis one-sample test). The impacts of age, sex, group composition, and group size on the different types of smiling and laughter were investigated with the Student *t*-test (to compare means between two samples) as well as univariate analyses of variance (to assess interaction effects between variables), and linear regression (to assess the impact of group size). Unfortunately, forced laughter did not represent a sizeable enough class of behaviour to allow parametric tests. Similarly, laughter intensities were combined into one category to perform univariate analysis.

The sample size in each age category was irregular, as most people observed were either young or mature adults. Therefore the four age classes mentioned earlier were lumped into two categories: young (coded as '0', and including adolescents and young adults), and mature (coded as '1', and including mature and old adults). The sex composition and the age composition of groups represented two different variables and were coded '0' for same, and '1' for mixed. Statistical analyses were performed with 'SPSS', and effect sizes (*d*, Cohen, 1969) were computed using 'Effect Size Generator 2.3' (Devilly, 2004).

The direction of smiling and laughter was also investigated in order to determine whether people directed their affiliative behaviours randomly between men and women, or to one sex in particular. This analysis was performed on a subset of 45 people (23 males, 22 females) interacting in mixed-sex groups. These people were selected on the basis that they were interacting in a group in which they had the

opportunity to direct their smiles and laughs either at a male or at a female. For example, a male interacting with two females could not direct his laughs or smiles at a man or a woman because he was simply the only man in the group.

For each selected individual, the proportion of smiles and laughs directed at males or females was calculated out of the total rate of smile or laughter displayed by that person. The observed proportion was then compared to the proportion that would be expected if people were to smile at either sex in a random fashion. It was assumed that if men and women received equal amount of smiles and laughs, the proportion of displays directed at either a man or a woman should not differ significantly from the availability of both sexes in the group. I counted the number of individuals for which the proportion of smiles and laughs were directed (a) more often to men than to women (more than 60% directed to men and less than 40% directed to women), (b) more often to women than to men (more than 60% directed to women and less than 40% directed to men), and (c) equally often to men and women (between 40 and 60 %). A Chi-square test was then used to compare these counts with the counts that would be expected from the availability of both sexes in the group.

3. Results

The predictions of each hypothesis will be tested separately in the order they were presented in the introduction. Because the direction of displays is relevant to the three hypotheses, this analysis will be presented at the end of the result section. The different types of smiles and laughs will be analysed separately. Forced laughter was relatively unfrequent and did not fulfill the assumtions underlying parametric tests. The results relative to laughter therefore refer to spontaneous laughter only.

3.1. The Mate Choice Hypothesis

The first prediction of the 'mate choice' hypothesis was that the frequency of smiling and laughter would be higher in mixed-sex than in same-sex groups. A Student *t*-test

revealed that smiling rates did not differ significantly in same-sex and in mixed-sex groups (spontaneous smiles: $t = 1.68$, $p = .09$; forced smiles: $t = 0.32$, $p = .75$). This indicates that both types of smiles were displayed at similar rates in same-sex (spontaneous smiles: $M = 0.56$, $SD = 0.49$; forced smiles: $M = 0.20$, $SD = 0.18$) and mixed-sex groups (spontaneous smiles: $M = 0.70$, $SD = 0.55$; forced smiles: $M = 0.20$, $SD = 0.17$).

Because laughter rates were expected to be affected by sex composition of groups in a different way in men and women, data were analysed separately for each sex. The analysis showed that female laughter rates differed significantly with the sex composition of groups, whereas male laughter did not. Women appeared to laugh significantly more often when they were interacting in mixed-sex groups than when they were interacting in same-sex groups (*Figure 2.1*).

Table 2.1. Mean rates per minute (and standard deviations) for spontaneous laughter displayed by men and women in same-sex and mixed-sex groups. $^{*}p < .05$, independent sample *t*-test.

	Same-Sex, n=93	*Mixed-Sex, n=119*	*t*	*d*
Men	0.57 (0.49)	0.58 (0.62)	0.81	.02
Women	0.40 (0.43)	0.70 (0.70)	2.29*	.51

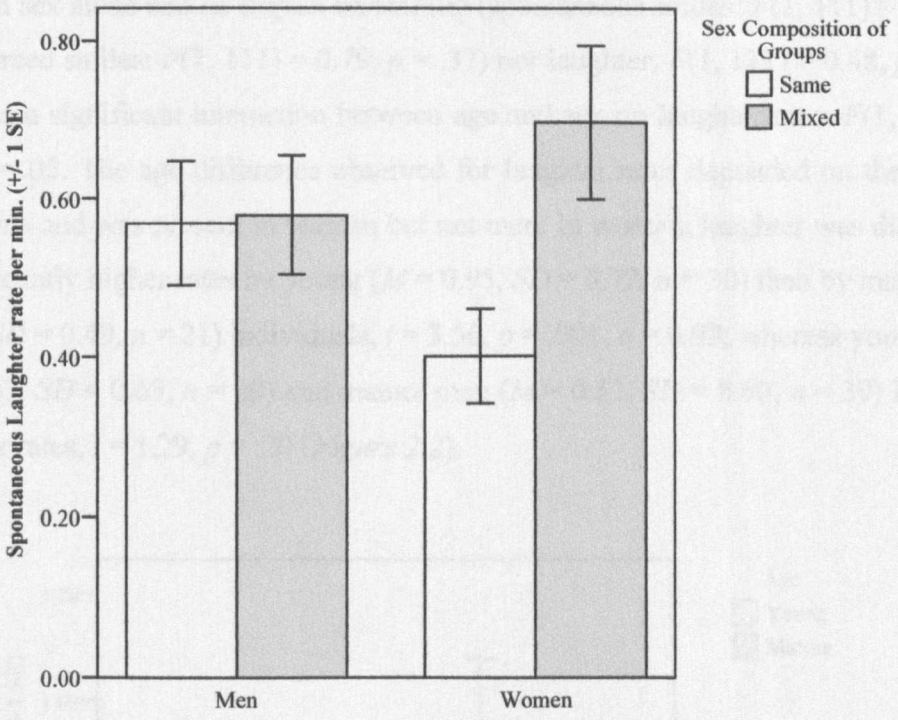


Figure 2.1. Effect of sex composition of groups on spontaneous laughter (mean rate per min.) in men and women.

The mate choice hypothesis also made predictions about the effect of age, sex, and age composition of groups on the frequency of affiliative behaviours displayed in mating contexts. A 2 × 2 × 2 univariate analysis of variance conducted in mixed-sex groups, with sex, age of focal, and age composition of groups as between-subject factors, showed that age of focal had a significant impact on both types of smiles and on laughter rates (*Table 2.2*). Young individuals displayed higher rates of smiling and laughter than mature individuals.

Table 2.2. Mean rates per minute (and standard deviations) for affiliative behaviours displayed in mixed-sex groups by young (under 35 years old) and mature (over 35 years old) individuals. $^{**}p<.005$

Behaviour	*Young, n=59*	*Mature, n=60*	*F(1, 115)*	*d*
Spontaneous smile	0.88 (0.59)	0.52 (0.43)	9.06**	.68
Forced smile	0.24 (0.17)	0.17 (0.17)	8.57**	.42
Spontaneous laughter	0.81 (0.69)	0.45 (0.57)	9.39**	.57

Although sex alone had no impact on smiling (spontaneous smiles: $F(1, 111) = 0.07$, $p = .79$; forced smiles: $F(1, 111) = 0.79$, $p = .37$) nor laughter, $F(1, 111) = 0.48$, $p = .48$, there was a significant interaction between age and sex on laughter rates $F(1, 115) = 3.75$, $p = .05$. The age difference observed for laughter rates depended on the sex of individuals and was present in women but not men. In women, laughter was displayed at significantly higher rates by young ($M = 0.95$, $SD = 0.72$, $n = 30$) than by mature ($M = 0.34$, $SD = 0.49$, $n = 21$) individuals, $t = 3.56$, $p = .001$, $d = 0.99$; whereas young men ($M = 0.67$, $SD = 0.65$, $n = 29$) and mature men ($M = 0.51$, $SD = 0.60$, $n = 39$) laughed at similar rates, $t = 1.29$, $p = .20$ (*Figure 2.2*).

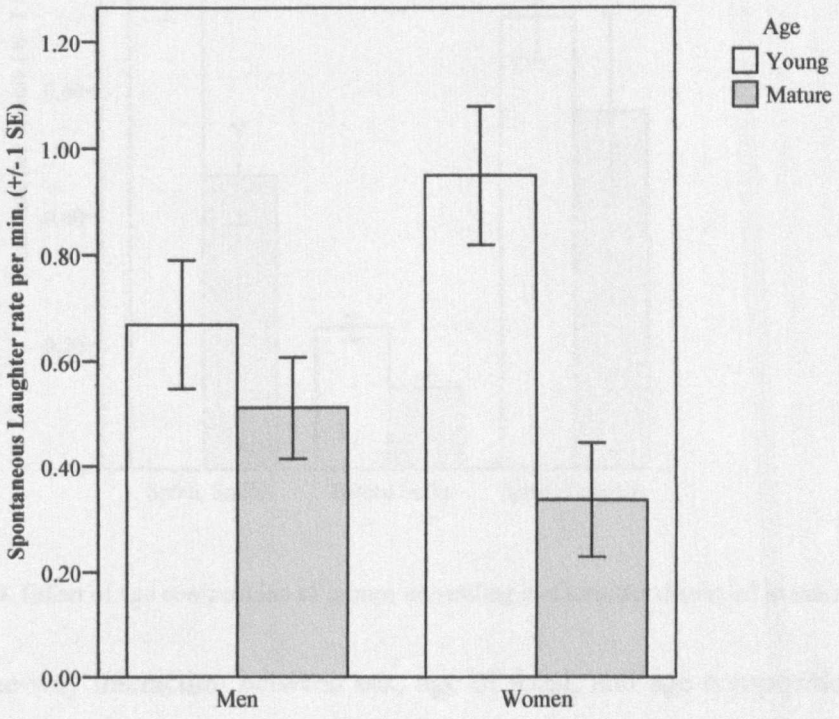


Figure 2.2. Effect of age on spontaneous laughter (mean rate per min.) displayed by men and women interacting in mixed-sex groups. Young (<35 years old) - Mature (>35 years old).

Still within mixed-sex interactions, there was a main effect of age composition of groups on spontaneous and forced smile rates, but not on laughter rates. Both types of smiles were displayed at significantly higher rates in same-age than mixed-age groups, whereas laughter was not affected by the age composition of groups (*Figure 2.3*). These results are presented in *Table 2.3*.

Table 2.3. Mean rates per minute (and standard deviations) for affiliative behaviours displayed in mixed-sex groups according to the age composition of groups. $^{*}p < .05$

Behaviour	*Same-Age, n=92*	*Mixed-Age, n=27*	*F(1, 111)*	*d*
Spontaneous smile	0.77 (0.56)	0.46 (0.41)	5.79*	.61
Forced smile	0.23 (0.19)	0.13 (0.10)	3.95*	.64
Spontaneous laughter	0.66 (0.61)	0.53 (0.78)	2.44	.18

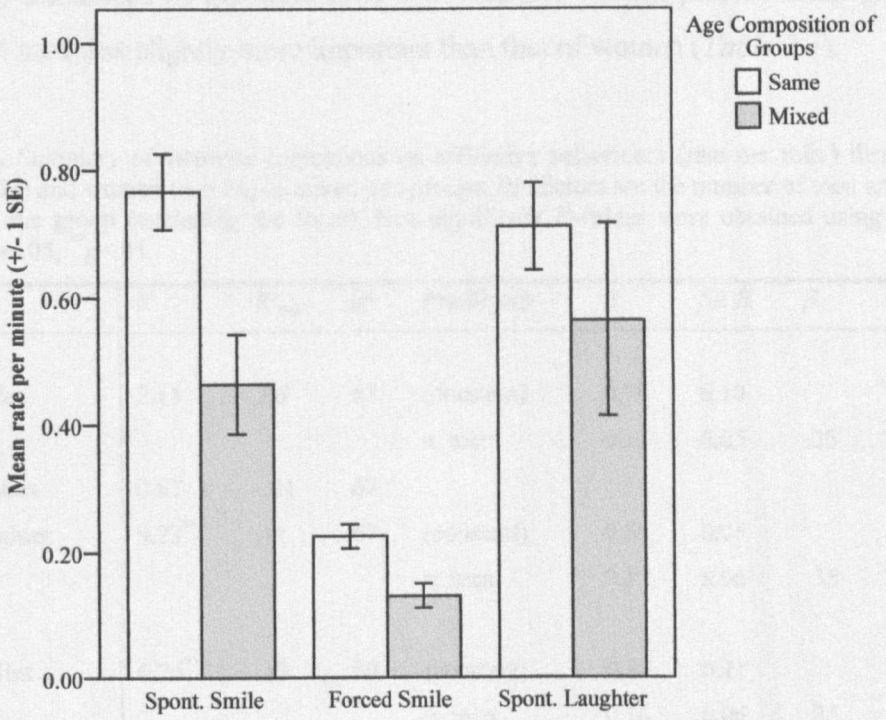


Figure 2.3. Effect of age composition of groups on smiling and laughter displayed in mixed-sex groups.

The three-way interaction between sex, age of focal, and age composition of groups was non-significant (spontaneous smiles: $F(1, 111) = 0.25$, $p = .62$; forced smiles: $F(1, 111) = 0.29$, $p = .57$; laughter: $F(1, 111) = 0.43$, $p = .51$). This suggests that in mixed-sex groups the effect of age composition was independent of people's age and sex.

The mate choice hypothesis also predicted that smiling and laughter rates would depend on the number of opposite-sex individuals present in the group. Stepwise regression analyses were performed to examine the effect of the number of males and females on smiling and laughter rates. Analyses were split by sex of focal and are presented in *Table 2.4*. Results show that the number of men had an impact on men's

spontaneous smiling and laughter, whereas men's affiliative behaviours in mixed-sex groups were unaffected by the number of women (*Figure 2.4*). On the other hand, women's spontaneous smiling was affected by the number of opposite-sex individuals (*Figure 2.5*) while it seemed to be unaffected by the number of other women. Interestingly this pattern was reversed for forced smiles, as these appeared to be positively related to the number of women, but not men. Although female laughter was positively influenced by the number of both men and women present in the group, the impact of men was slightly more important than that of women (*Table 2.4*).

Table 2.4. Summary of stepwise regressions on affiliative behaviours (rate per min.) displayed by men (n = 68) and women (n = 51) in mixed-sex groups. Predictors are the number of men and women present in the group (excluding the focal). Non-significant F-values were obtained using the enter method. $^{*}p<.05$, $^{**}p<.01$

	F	R^2_{adj}	df	*Predictors*	B	$SE\ B$	β	t
Men								
Spont.smiles	2.11	.06	67	(constant)	0.78	0.10		7.58**
				n. men	0.11	0.05	.26	2.04*
Forced smiles	0.67	-.01	67					
Spont. laughter	9.23**	.11	67	(constant)	0.56	0.05		10.19**
				n. men	0.17	0.06	.35	3.04**
Women								
Spont. smiles	6.74**	.10	50	(constant)	0.50	0.11		4.56**
				n. men	0.16	0.06	.35	2.60**
Forced smiles	9.40**	.14	50	(constant)	0.36	0.03		12.41**
				n. women	0.07	0.02	.40	3.07**
Spont. laughter	8.92**	.24	50	(constant)	0.30	0.12		2.55*
				n. men	0.19	0.07	.35	2.76**
				n. women	0.14	0.06	.30	2.34*

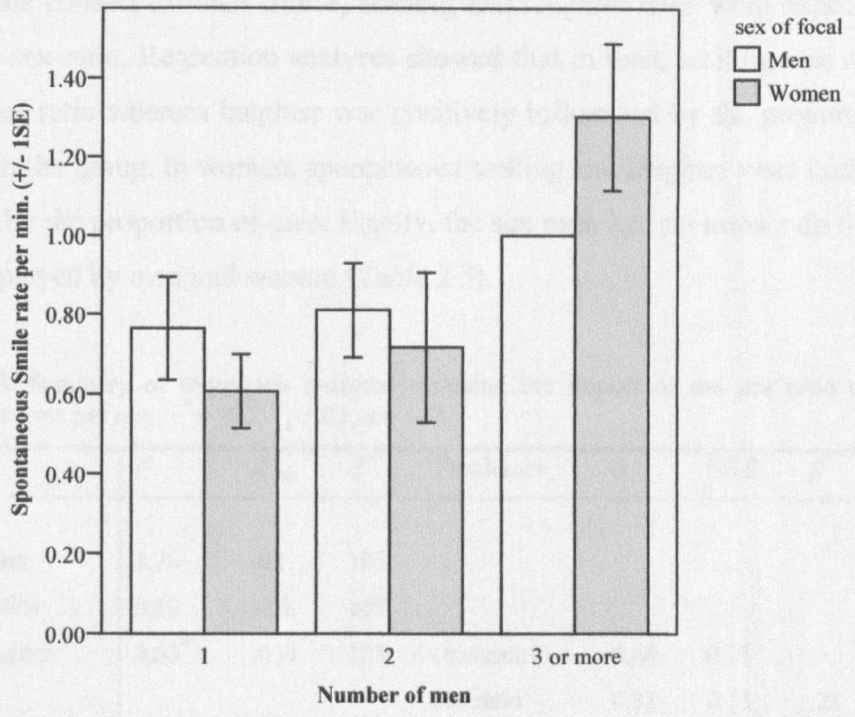


Figure 2.4. Effect of the presence of men on spontaneous smiles (mean rate per min.).

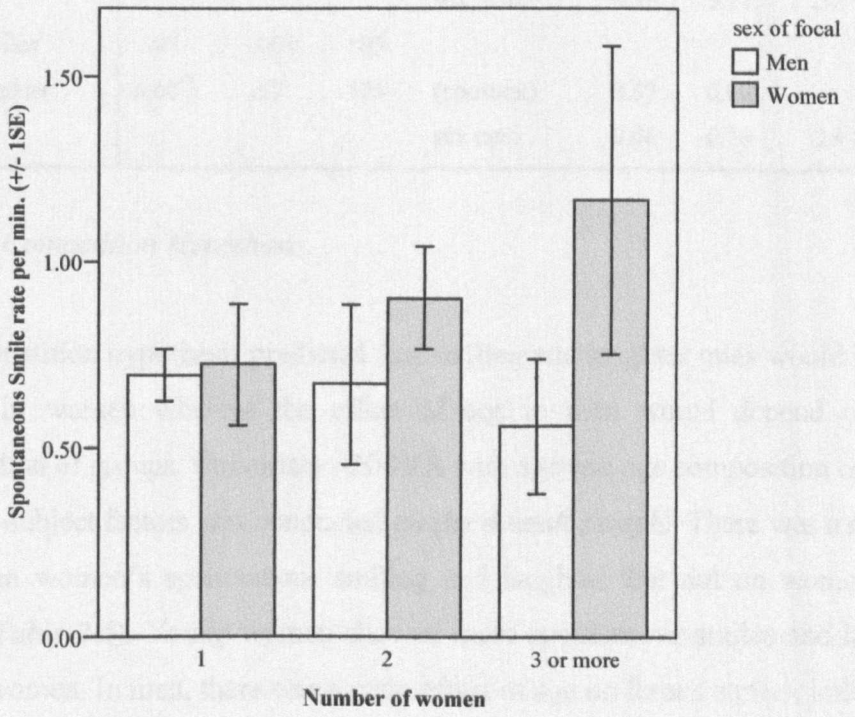


Figure 2.5. Effect of the presence of women on spontaneous smiles (mean rate per min.).

Still in the context of mate choice, smiling and laughter rates were expected to vary with the sex ratio. Regression analyses showed that in men, smiling was not affected by the sex ratio whereas laughter was positively influenced by the proportion of men present in the group. In women, spontaneous smiling and laughter were both positively affected by the proportion of men. Finally, the sex ratio had no impact on forced smile rates displayed by men and women (*Table 2.5*).

Table 2.5. Summary of regression analyses assessing the impact of the sex ratio on affiliative behaviours (rate per min.). $^{*}p<.05$, $^{**}p<.01$, $n = 119$

	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Men								
Spont.smiles	2.76	.02	105					
Forced smiles	0.16	-.01	105					
Spont. laughter	4.63*	.034	105	(constant)	0.46	0.11		4.03**
				sex ratio	0.33	0.15	.21	2.15*
Women								
Spont. smiles	8.01**	.06	105	(constant)	0.63	0.50		12.72**
				sex ratio	0.39	0.14	.27	2.83**
Forced smiles	1.07	.001	105					
Spont. laughter	8.68**	.07	105	(constant)	0.57	0.06		9.97**
				sex ratio	0.46	0.16	.28	2.95**

3.2. The Competition Hypothesis

The competition hypothesis predicted that smiling and laughter rates would be affected by age in women whereas the effect of age in men would depend on the age composition of groups. Univariate ANOVA with age and age composition of groups as between-subject factors was conducted ***on the overall sample***. There was a main effect of age on women's spontaneous smiling and laughter, but not on women's forced smiles (*Table 2.6*). Young women showed more spontaneous smiles and laughs than mature women. In men, there was a main effect of age on forced smiles, indicating that young individuals displayed more deliberate smiles than mature ones.

Table 2.6. Mean rates per minute (and standard deviations) for affiliative behaviours displayed by young (<35 years old) and mature (>35 years old) men and women. $^{(\cdot)}p<.10$, $^{*}p<.05$, $^{**}p<.01$

Behaviour	*Young*	*Mature*	*F(1, 102)*	*d*
Men	$n = 49$	$n = 57$		
Spontaneous smile	0.81 (0.58)	0.58 (0.43)	$2.82^{(\cdot)}$	.46
Forced smile	0.24 (0.19)	0.19 (0.20)	10.18^{**}	.22
Spontaneous laughter	0.66 (0.62)	0.50 (0.53)	0.72	.28
Women	$n = 57$	$n = 49$		
Spontaneous smile	0.73 (0.57)	0.42 (0.44)	6.66^{*}	.61
Forced smile	0.22 (0.17)	0.17 (0.12)	1.76	.42
Spontaneous laughter	0.70 (0.63)	0.36 (0.48)	9.04^{**}	.62

In addition, there was a significant interaction age × age composition of groups on men's forced smiles rates, $F(1, 102) = 10.25$, $p < .005$. Analysis conducted in mixed-age groups showed that young men displayed higher rates of forced smiles ($M = 0.26$, $SD = 0.13$, $n = 10$) than mature men ($M = 0.06$, $SD = 0.11$, $n = 12$), $t = 3.83$, $p = .001$, $d = 1.63$. On the other hand, mature men showed significantly fewer forced smiles when observed with young people ($M = 0.06$, $SD = 0.11$, $n = 12$) than when observed with people of their own age class ($M = 0.23$, $SD = 0.20$, $n = 45$), $t = 3.72$, $p = .001$, $d = 0.97$. These results are illustrated in *Figure2.6*. In men still, there was no interaction between age and age composititon of groups on spontaneous smiling, $F(1, 102) = 0.10$, $p = .75$, nor laughter, $F(1, 102) = 0.39$, $p = .53$.

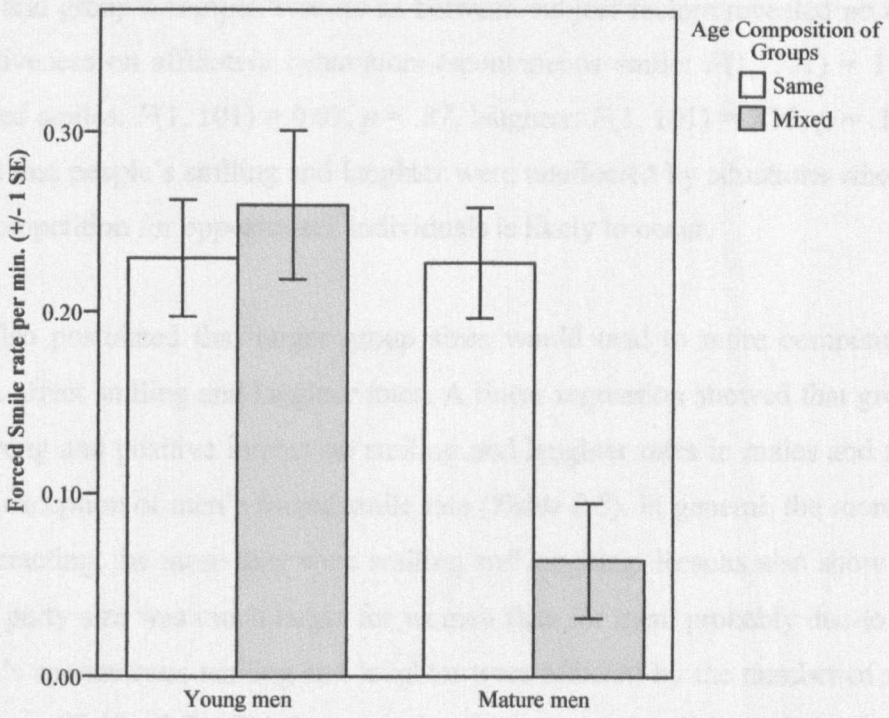


Figure 2.6. Effect of age composition of groups on forced smile (rate per min.) in young (<35 years old) and mature (>35 years old) men.

Overall, there was no sex difference in the frequencies of affiliative behaviours, suggesting that men and women smiled and laughed at similar rates (*Table 2.7*).

Table 2.7. Mean rates per minute (and standard deviation) of affiliative behaviours displayed by men and women. *t*-values are non-significant.

Behaviour	*Men, n=106*	*Women, n=106*	*t*	*d*
Spontaneous smile	0.69 (0.51)	0.59 (0.54)	1.73	0.19
Forced smile	0.21 (0.20)	0.20 (0.15)	-0.04	0.09
Spontaneous laughter	0.57 (0.57)	0.54 (0.59)	1.05	0.05

The competition hypothesis predicted that smiling and laughter rates would be higher in competitive situations, e.g. in mixed-sex groups. These groups were classified as 'competitive' on the basis that they included at least another individual of the same sex class as the focal. Groups that did not fulfil this condition were classified as 'non-competitive' and dyads were excluded from the analysis. Univariate ANOVA with sex

of focal and group's competitiveness as between-subject factors revealed no effect of competitiveness on affiliative behaviours (spontaneous smile: $F(1, 101) = 1.99$, $p = .16$, forced smiles: $F(1, 101) = 0.03$, $p = .87$, laughter: $F(1, 101) = 2.73$, $p = .10$). This indicates that people's smiling and laughter were unaffected by situations where intra-sexual competition for opposite-sex individuals is likely to occur.

It was also postulated that larger group sizes would lead to more competition and therefore affect smiling and laughter rates. A linear regression showed that group size had a strong and positive impact on smiling and laughter rates in males and females, with the exception of men's forced smile rate (*Table 2.8*). In general, the more people were interacting, the more they were smiling and laughing. Results also show that the effect of party size was much larger for women than for men, probably due to the fact that men's spontaneous smiling and laughter were affected by the number of men but not women (*Table 2.9*). On the other hand, women's smiling and laughter were influenced by the number of both men and women, with the effect of men being larger than that of women for spontaneous smile and laughter rates. The effect of group size on smiling and laughter is illustrated in the *Figures 2.7, 2.8,* and *2.9*.

Table 2.8. Summary of regression analyses on affiliative behaviours (rate per min.) displayed by men and women. Predictor is overall group size. $^{*}p<.05$, $^{**}p<.01$

	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Men								
Spont.smiles	4.10*	.03	105	(constant)	0.60	0.08		7.25**
				group size	0.05	0.03	.19	2.02*
Forced smiles	1.22	.002	105					
Spont. laughter	5.35*	.04	105	(constant)	0.48	0.09		5.44**
				group size	0.07	0.03	.22	2.31*
Women								
Spont. smiles	16.56**	.13	105	(constant)	0.34	0.09		3.95**
				group size	0.11	0.03	.37	4.07**
Forced smiles	12.34**	.10	105	(constant)	0.24	0.05		4.96**
				group size	0.05	0.02	.33	3.51**
Spont. laughter	29.91**	.22	105	(constant)	0.14	0.09		1.48
				group size	0.16	0.03	.47	5.47**

Table 2.9. Stepwise regression analyses on affiliative behaviours (rate per min.) displayed by men and women. Predictors are the number of men and women present in the group (excluding the focal). $^{*}p<.05$, $^{**}p<.01$

	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Men								
Spont.smiles	5.05*	.04	105	(constant)	0.70	0.04		16.58**
				n. men	0.06	0.02	.21	2.25*
Forced smiles	0.61	-.01	105					
Spont. laughter	7.70**	.06	105	(constant)	0.59	0.04		13.29**
				n. men	0.07	0.03	.26	2.77**
Women								
Spont. smiles	8.96**	.13	105	(constant)	0.47	0.06		7.47**
				n. men	0.14	0.03	.37	3.95**
				n. women	0.09	0.04	.21	2.29*
Forced smiles	6.26**	.09	105	(constant)	0.29	0.03		8.24**
				n. women	0.06	0.02	.28	2.97**
				n. men	0.05	0.02	.24	2.48**
Spont. laughter	15.30**	.21	105	(constant)	0.31	0.07		4.62**
				n. men	0.18	0.04	.43	4.89
				n. women	0.14	0.04	.31	3.51

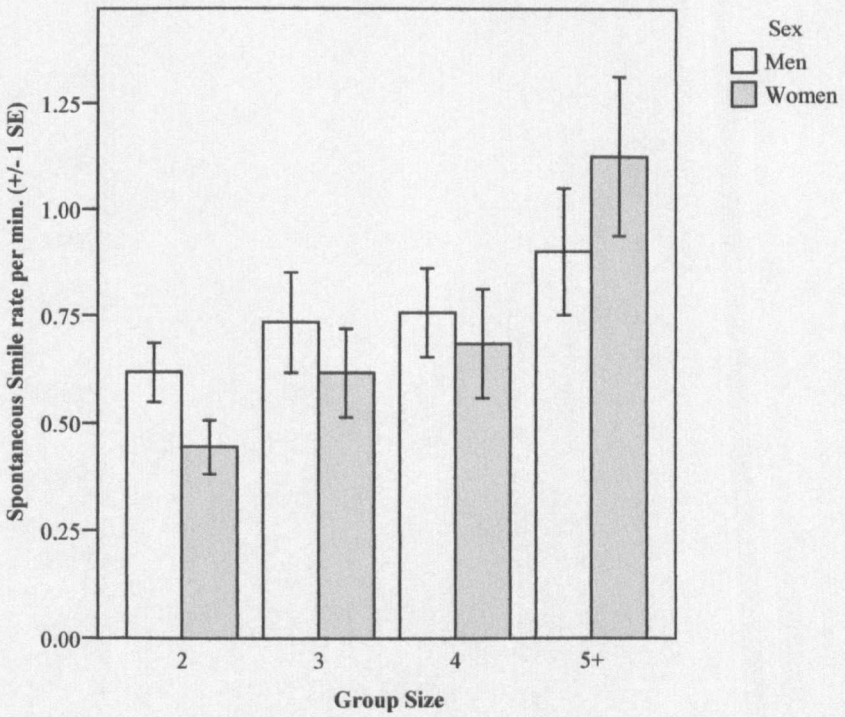


Figure 2.7. Effect of group size on spontaneous smiles (mean rate per min.) in men and women.

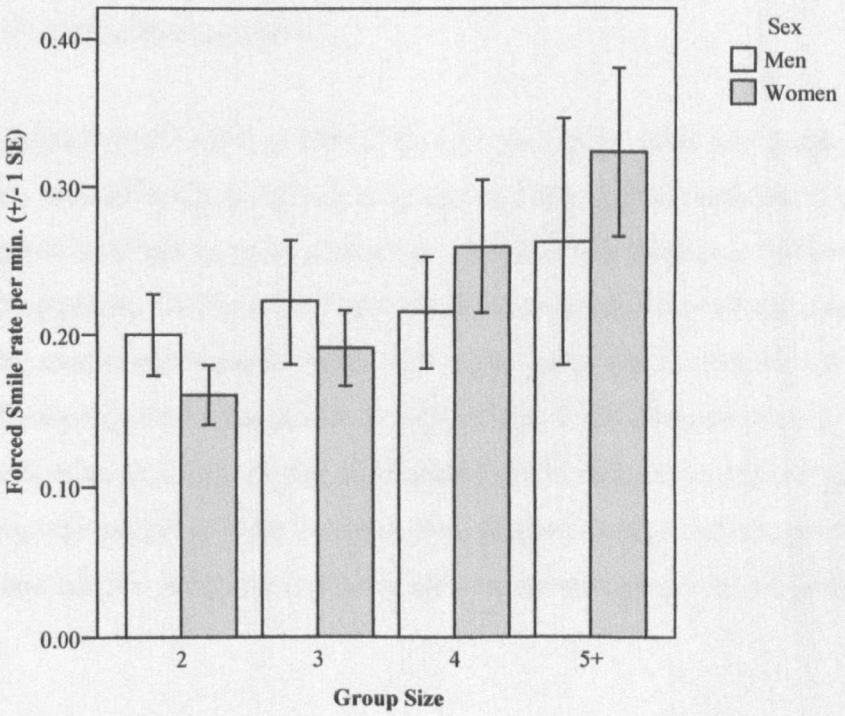


Figure 2.8. Effect of group size on forced smiles (mean rate per min.) in men and women.

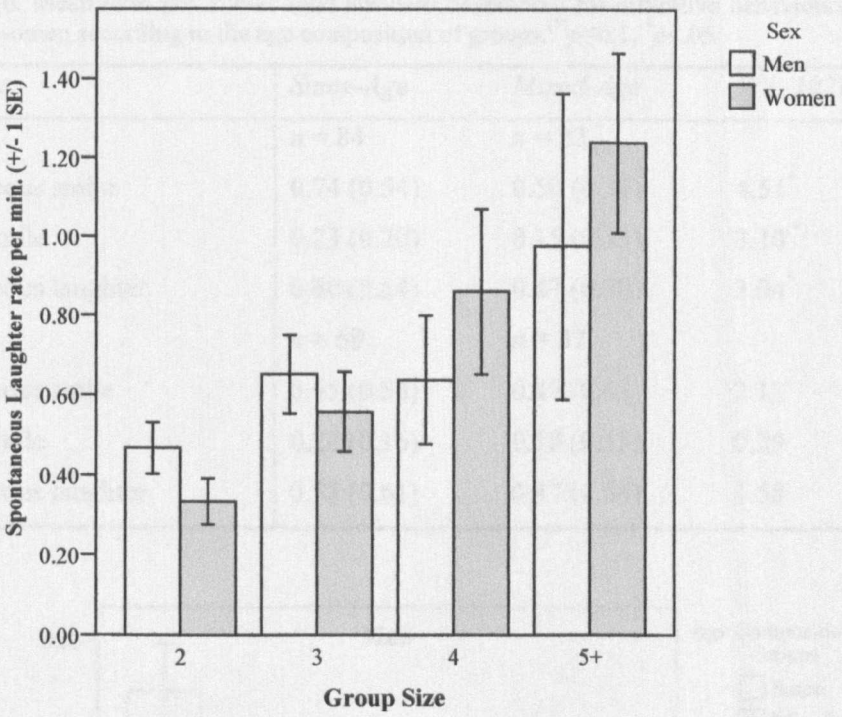


Figure 2.9. Effect of group size on spontaneous laughter (mean rate per min.) in men and women.

3.3. The Cooperation Hypothesis

The cooperation hypothesis predicted that people would smile and laugh more when interacting with individuals of their own age and sex. Results relative to the effect of sex composition of groups were already presented in this section and showed no effect of sex composition. On the other hand, there was a main effect of age composition of groups on men's spontaneous smile and on laughter rates, whereas the effect was marginally significant for forced smile rates (*Table 2.10*). Men displayed significantly higher rates of spontaneous smiles and laughs (and to some extent forced smiles) when interacting with people of their own age class (*Figure 2.10*), whereas women appeared to smile and laugh equally often in same-age and mixed-age groups (*Figure 2.11*).

Table 2.10. Mean rates per minute (and standard deviations) for affiliative behaviours displayed by men and women according to the age composition of groups. $^{(*)}p<0.1$, $^{*}p<.05$

Behaviour	*Same-Age*	*Mixed-Age*	*F(1, 102)*	*d*
Men	$n = 84$	$n = 22$		
Spontaneous smile	0.74 (0.54)	0.50 (0.36)	4.54^{*}	.52
Forced smile	0.23 (0.20)	0.15 (0.15)	$3.10^{(*)}$	.42
Spontaneous laughter	0.60 (0.54)	0.47 (0.70)	3.94^{*}	.21
Women	$n = 69$	$n = 37$		
Spontaneous smile	0.65 (0.58)	0.47 (0.43)	2.13	.34
Forced smile	0.20 (0.16)	0.18 (0.15)	0.29	.15
Spontaneous laughter	0.58 (0.61)	0.47 (0.56)	1.58	.19

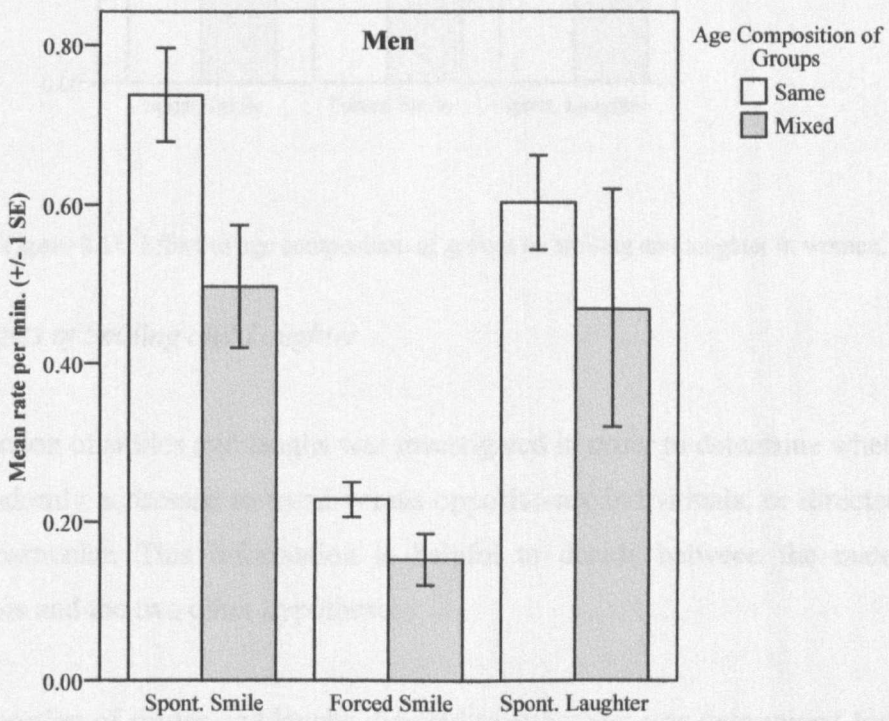


Figure 2.10. Effect of age composition of groups on smiling and laughter in men.

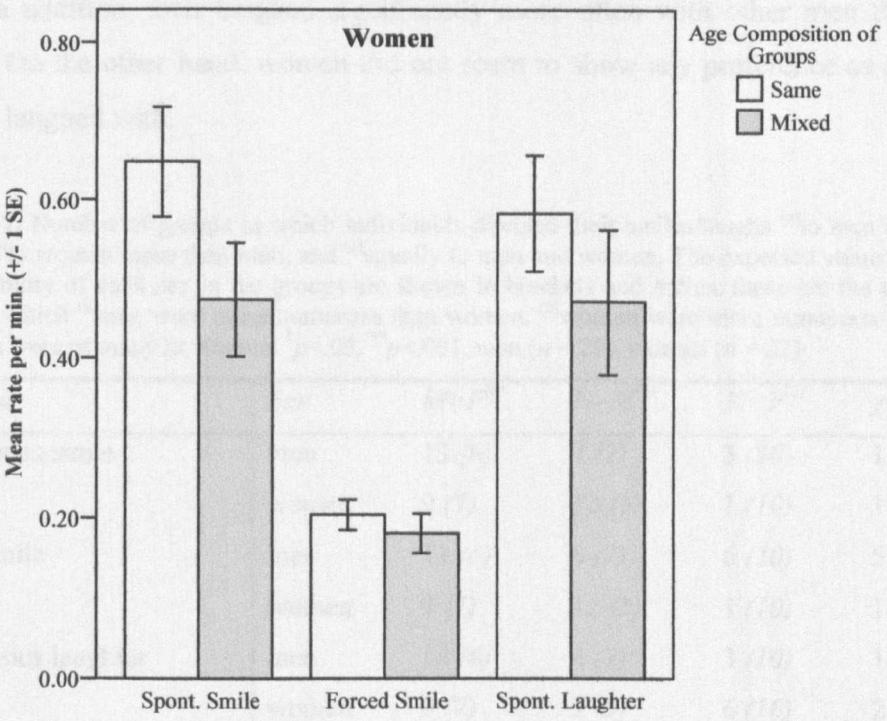


Figure 2.11. Effect of age composition of groups on smiling and laughter in women.

3.4. Targets of Smiling and Laughter

The direction of smiles and laughs was investigated in order to determine whether they were randomly addressed to same versus opposite-sex individuals, or directed to one sex in particular. This information is helpful to decide between the mate choice hypothesis and the two other hypotheses.

The proportion of smiles and laughs directed to either sex was determined for 23 men and 22 women observed in groups in which they had the opportunity to show their display to either a man or a woman. Because the number of males and females differed between interacting groups, the expected values were calculated according to the proportion of males and females available in the groups (for details on that analysis see section 2.4). Results showed that the various forms of smiling and laughter were not randomly directed to men and women (*Table 2.11*). Both types of smiles tended to be directed to same-sex individuals more often than it would be expected by chance

alone. In addition, men laughed significantly more often with other men than with women. On the other hand, women did not seem to show any preference as to which sex they laughed with.

Table 2.11. Number of groups in which individuals directed their smiles/laughs [(a)]to men more than women, [(b)]to women more than men, and [(c)]equally to men and women. The expected values based on the availability of each sex in the groups are shown in brackets and italics, these are the number of groups in which [(a)]men were more numerous than women, [(b)]women were more numerous than men, and [(c)]men were as many as women. $^{*}p<.05$, $^{**}p<.001$, men ($n = 23$), women ($n = 22$)

Behaviour	*Sex*	*M>F[(a)]*	*F>M[(b)]*	*M=F[(c)]*	χ^2
Spontaneous smile	men	13 *(6)*	7 *(7)*	3 *(10)*	13.06**
	women	9 *(7)*	12 *(5)*	1 *(10)*	18.47**
Forced smile	men	11 *(6)*	6 *(7)*	6 *(10)*	5.91*
	women	9 *(7)*	12 *(5)*	1 *(10)*	18.47**
Spontaneous laughter	men	14 *(6)*	6 *(7)*	3 *(10)*	15.71**
	women	9 *(7)*	7 *(5)*	6 *(10)*	2.97

3.5. Test of Hypotheses

The predictions derived from the three hypotheses are summarised in *Table 2.12*. The objective here is to match the pattern of results observed for the different types of smiling and laughter to the pattern generated by the predictions of the three hypotheses. This procedure should allow us to find which hypothesis best fits the observed data (Dunbar *et al.*, 2002). Entries marked '0' are expected to yield non-significant relationships whereas entries marked with a sign are expected to give relationships in the expected direction. There were 17 tests and three possible answers per test (+, – or 0), which makes a total of 51 possible outcomes for each hypothesis. The number of predicted outcomes for each hypothesis was used to estimate the expected number of correct tests that would occur given a random allocation of outcomes.

Table 2.12. Predicted relationships for smiling (S) and laughter (L) rates for the three hypotheses. Key: Plus signs represent a positive relationship, minus signs represent a negative relationship, and zeros represent no relationship. [1]Interaction with age. [2]Within mixed-sex groups. [3]Interaction with age composition of groups. (t)*Target of behaviour. S.Smile: spontaneous smiles, F.Smile: forced smiles, S.Laugh: spontaneous laughter.

	Predictions						*Results*		
	Mate choice		Competition		Cooperation				
	S	L	S	L	S	L	S.Smile	F.Smile	S.Laugh
men>women	+/–[2]	+/–[2]	–	0	0	0	0	0	0
Men									
age	0	0	–[3]	–[3]	0	0	–[2]/0	–[2]/–[3]	0
same>mixed sex	–	–	0	–	+	+	0	0	0
same>mixed age	–[1,2]	–[1,2]	–[1]	–	+	+	+	+[1,2]/0	0[2]/+
group size	0	0	+	+	+/–	+	+	0	+
n° of men	–	–	0[2]/+	+	+	+	+	0	+
n° of women	+	+	–	–	0	0	0	0	0
sex ratio	–	–	0	+	+	+	0	0	+
(t)*men>women	–	–	+	+	+	+	+	+	+
Women									
age	–[2]	–[2]	–[3]	–[3]	–	–	–	–[2]/0	–
same>mixed sex	–	–	–	–	0/+	0/+	0	0	–
same>mixed age	–[1,2]	–[1,2]	–[1]	–[1]	+	+	+[2]/0	+[2]/0	0
group size	0	0	+	+	+/–	+	+	+	+
n° of men	+	+	–	–	0/+	0/+	+	+	+
n° of women	–	–	+[2]	+[2]	+	+	0[2]/+	+	+
sex ratio	+	+	–	–	–	–	+	0	+
(t)*men>women	+	+	–	–	–	–	–	–	0

Table 2.13 shows the results of the chi-square analysis that tests whether the number of 'hits' between each test and the respective predictions differs from what would be expected by chance. This procedure shows that matches between predictions and results relative to spontaneous smiling and laughter are not distributed evenly between the three hypothesis, (spontaneous smiling: $\chi^2 = 6.78$, $p < .05$, $df=2$; spontaneous laughter: $\chi^2 = 6.27$, $p < .05$, $df=2$). Partitioning chi-square indicates that these results are due to the contrast between the cooperation hypothesis and the other two (*Table*

2.13). The mate choice and the competition hypotheses were poorly supported by the data. Finally, results relative to forced smiling seemed not to support any of the three hypotheses.

Table 2.13. Chi-square values for the tests of the three hypotheses.* Expected values are calculated on the basis of the proportion of all possible outcomes (three for each test) that would occur by chance (as predicted by each hypothesis). This is calculated from the total number of entries in the prediction column for each hypothesis, divided by the maximum possible (3 options × 17 tests = 51) times the number of possible outcomes (17).

	Hypotheses		
	Mate choice	Competition	Cooperation
Spontaneous Smile			
n° of tests confirmed (max=17)	4	8	13
Expected*	6	5.7	7
χ^2 (*df*=1)	0.67	0.97	5.14
p	n.s.	n.s.	<.05
Forced Smile			
n° of tests confirmed (max=17)	3	8	8
Expected*	6	5.7	7
χ^2 (*df*=1)	1.5	0.97	0.14
p	n.s.	n.s.	n.s.
Spontaneous Laughter			
n° of tests confirmed (max=17)	5	9	12
Expected*	6	5.7	6.7
χ^2 (*df*=1)	0.17	1.91	4.19
p	n.s.	n.s.	<.05

4. Discussion

This chapter showed that the frequencies of smiling and laughter vary with diverse aspects of the social environment. The size of the interacting party was probably the variable with the most significant impact on smiling and laughter, with rates increasing as a function of group size. In addition, the age of people involved appeared to have a large influence on smiling and laughter. Although the sex of individuals did not

particularly affect overall frequencies of smiling and laughter, sex did mediate the effect of the other variables on these behaviours. The present results will be interpreted in light of the three hypotheses introduced at the beginning of this chapter: the mate choice hypothesis, the competition hypothesis, and the cooperation hypothesis.

4.1. The Mate Choice Hypothesis

The mate choice hypothesis predicted that smiling and laughter would vary with the sex composition of groupings, with people showing higher rates of these behaviours when interacting in mixed-sex groups as opposed to single-sex groups. Data did not show any effect of sex composition of groups on smiling rates, indicating that people smiled equally often in the presence of males and females. Moreover in men, smiling and laughter were unrelated to the number and the proportion of women present in the group, while one would expect signals of mate quality to increase with the proportion of opposite-sex individuals. It is therefore unlikely that smiling and laughter are central components of males' courtship strategies.

On the other hand, results relative to female's laughter could be compatible with the mate choice hypothesis. Indeed, women laughed at higher rates in the presence of men, a finding that supports earlier studies that underlined the relevance of mixed-sex contexts on women's laughter (Grammer & Eibl-Eibesfeldt, 1990; Smoski & Bachorowski, 2003). In addition, female's laughter was positively related to the proportion of men present in the group, and although it was also related to the number of other women, the number of men had a higher impact on women's laughter. All in all, these results suggest that laughter is not completely alien to women's courtship.

Another prediction of the mate choice hypothesis was that smiling and laughter would be preferentially directed to members of the opposite sex. Although women's smiling and laughter appeared to be more strongly related to the number of males than to the number of females, the tendency was that - when interacting in mixed-sex groups - people generally smiled to individuals of their own sex, a finding that goes against the mate choice hypothesis. In that respect, laughter gave slightly different

results depending on the sex of the individual considered. Men laughed more with other men than with women but women did not seem to show any preference as to which sex they laughed with. Consequently, the results relevant to the direction of affiliative behaivours did not support the mate choice hypothesis.

The mate choice hypothesis also predicted a sex difference in the amount of smiling and laughter that people should be expected to display if these behaviours were advertising mate quality. LaFrance and colleagues (2003) extensively reviewed the existing literature on smiling and found consistent sex differences indicating that women smile more than men. Despite a large sample size, the present results did not show any absolute sex difference in smiling and laughter rates. The absence of sex difference in overall rates of smiling could be explained by several factors. First, cultural factors are known to affect the display of facial expressions (Ekman & Friesen, 1971), and LaFrance *et al.* (2003) did actually notice that the magnitude of the sex difference was less important in the British samples included in their meta-analysis. Second, most studies mentioned in reviews were conducted in university environments that generally provides credit for participating to experiments. Hence these studies could easily be tainted with 'social desirability' effects. Because women are generally more concerned with positive self-presentation (DePaulo, 1992), higher rates of smiling in women could result from their greater compliance with experimental settings. No matter which explanation is right, the absence of a sex difference in this study does not support predictions drawn from the mate choice hypothesis.

The last element to consider in respect to the mate choice hypothesis is the effect of age on smiling and laughter rates. If smiling and laughter inform on the reproductive potential of individuals it would make sense that cues advertising such potential would be displayed in the period where reproduction is more likely to yield the best outcomes. Because female - but not male - fertility is limited by age, one should expect women's sexual displays to be more frequent at a younger age while men's courtship behaviours should stay constant throughout the life span. Within mixed-sex groups, young people were found to be smiling more frequently than older ones independently of the sex of the person. On the other hand, there was an interaction effect between age

and sex on laughter rates showing that younger females laughed more than mature ones while men laughed at similar rates regardless of age. Therefore it is not completely excluded that laughter plays a role as a courtship display in women. It is also important to mention that the number of individuals observed who were actually engaged in courtship remains unknown.

4.2. The Competition Hypothesis

The competition hypothesis assumes that people compete with individuals of their own sex in order to gain access to opposite-sex partners. In this context smiling and laughter could be used to appease tensions, as it has already been observed in humans (Goldenthal *et al.*, 1981), and in other species for homologous displays (van Hooff, 1972; Preuschoft, 1992). Data showed that people's smiles and laughs were unaffected by situations where intra-sexual competition for opposite-sex individuals is likely to occur, a result that contradicts the possibility that smiling and laughter mainly function to appease tensions associated with competitive situations.

Another way through which smiling has been proposed to regulate competition is to signal social status to others and thereby thwart the development of dominance related conflicts. It is reasonable to assume that the outcome of a conflict is potentially more damaging for low-power individuals than for high-power ones. Therefore tension reduction is expected to be a social strategy favoured by 'subordinate' individuals. This tendency has been largely documented in the primatological literature (Preuschoft & van Hooff, 1997), and it seems to be particularly pronounced in species where status differentials are high, e.g. in rhesus macaques (de Waal & Luttrell, 1985; Thierry, 1985). The importance of hierarchical relationships to human social life should certainly not be neglected (Mealey, 1985; Müller & Mazur, 1998). Given the salary scale and the distribution of responsibilities in our society, social status in the western world is indirectly related to age. Hence in our sample, groups in which people of different age classes interacted together were seen as groups with high hierarchical disparities. It was therefore predicted that smiling (and eventually laughter) would be higher in those groups as opposed to same-age groups. The overall data did not support

this prediction. On the contrary, smiling and laughter rates were highest when people were observed interacting in same-age groups, and this effect was stronger in men than in women.

Males'– but not females' – forced smiles appeared to be affected by age and age composition of groups in a way that could be compatible with the competition hypothesis. In fact, the interaction between age and age composition of groups showing that young males displayed significantly more forced smiles than mature males when interacting in mixed-age groups suggests that forced smiles in men could be interpreted as a submissive display. Nonetheless, the trend seemed to be for mature men to smile *less* in mixed-age than in same-age groups rather than for young men to smile more. This indicates that mature men might have refrained from smiling when interacting with younger individuals, while it was predicted from the competition hypothesis that young men would increase their smiling in the presence of mature men.

The connection between affiliative behaviours, age, and competition is not restricted to the position in the hierarchy. For example, it was postulated that in the context of social competition age could affect female smiling and laughter for the same reason as it could in the context of mate choice. If female competition is more important around peak fertility, and if women have a tendency to avoid damaging consequences related to open conflicts (Campbell, 2002), age should be negatively related to smiling and laughter rates. That is exactly what the results showed and the fact that female smiling was mainly directed to other females suggests that it might have more to do with intra-sexual relationships than with mate selection. Nonetheless, if smiling was used by women in intra-sexual competition, it should also be negatively related to the proportion of men in mixed-sex groups, as fewer men around would mean more competition. This prediction was not supported by the data, as women's smiling and laughter rates were higher when the sex ratio was biased towards males. Consequently, the effect of age on women's smiling and laughter does not fit the competition hypothesis.

Another prediction of the competition hypothesis was that frequencies of smiling and laughter should increase in line with party size, as one should expect more competition in larger groups. This prediction was supported by the data, and overall rates of smiling and laughter increased with the number of people involved in the interaction. Interestingly, the effect of group size appeared to be more important in females than in males, as the variance in men's affiliative behaviours explained by party size was 3% (spontaneous smiles) and 4 % (laughter), against 13%, 10% and 22% for women spontaneous smiles, forced smiles, and laughter, respectively. This difference is probably due to the fact that male's affiliative displays increased with the number of men but was unaffected by the number of women, whereas female's smiling and laughter were influenced by the number of both men **and** women.

The observed pattern in men seems to support the competition hypothesis, as with more men around one should expect more competition, hence more attempts to offset it through the use of affiliative displays. Furthermore in mixed-sex groups, men showed a preference to address their laughs and smiles to other men rather than to women. Although this seems to support the competition hypothesis, it was stated earlier that men would avoid displaying 'submissive' cues in the presence of women, and the present results contradict this prediction. All in all, the data weakly support the competition hypothesis, and might be better explained by the cooperation hypothesis.

4.3. The Cooperation Hypothesis

Of the three hypotheses introduced in the present chapter, the cooperation hypothesis was the one that received most support from the data (see *Table 2.13*). The cooperation hypothesis predicted that smiling and laughter would be directed towards same-sex individuals. Data showed that it was the case for smiling, with little variation between sexes. Men and women more often directed their smiles to people of their own sex regardless of the type of smile considered. This trend was also present for male's – but not female's – laughter. As far as the direction of smiles (and male's laughter) is concerned, the cooperation hypothesis is partly supported. Other aspects of group

composition have to be considered to provide further evidence in favour of the cooperation hypothesis.

One of the main predictions of the cooperation hypothesis was that age similarity between people would produce higher rates of smiling and laughter. The present results confirmed this prediction for males but not for females. Effect sizes relative to the impact of age composition of groups indicated a moderate effect in men but a weak effect in women. Men showed significantly more affiliative behaviours when observed with people of the same age class, whereas women's displays were more influenced by their own age rather than by the age of their interacting partners.

The effect of age on women's affiliative behaviour is also compatible with the assumption that smiling and laughter are involved in the formation and maintenance of cooperative relationships. Social networks can be viewed as circles of relationships in which people exchange emotional and economic support when in need (Dunbar, 1996a). Research conducted on social networks showed that people have more social contacts with friends at a younger age (Due *et al.* 1999), although the trend is absent in men, who still have frequent interactions with friends when older (Olsen *et al.* 1991). Interestingly, the effect of age on smiling and laughter was much stronger in women than in men. On average, young women smiled and laughed more than mature ones. Although age affected men's smiling rates in mixed-sex groups, the overall effect of age on men smiling and laughter was non-significant. Assuming that men, but not necessarily women, keep elevated levels of contacts with their friends over the lifetime, these findings suggest that smiling and laughter might play a role in maintaining social relationships.

There are a few reasons why people could be expected to seek more alliances at a younger age. First, the potential benefits of such alliances could be larger for young people because the prospective period during which favours can be reciprocated should be longer when started earlier. Second, young individuals might need more social support as a result of their having fewer resources than older and higher status individuals. This could be particularly true for women who find themselves at the early

stage of their reproductive life. Finally, young people might be in search for cooperative partners because a shorter life span could have resulted in a lower number of secured alliances. With this in mind, the interaction effect between age and age composition of groups on male forced smile rates might be better explained by the cooperation hypothesis than by the competition hypothesis. Remember that the effect of age composition of groups was particularly marked for mature men, and their rates of deliberate smiles showed a severe decrease when observed in mixed-age as opposed to same-age groups. The observation that mature men showed fewer forced smiles in mixed-age groups might reflect an adjustment to 'poorer' perceived opportunities for valuable alliances when interacting with younger people. Besides, the fact that young individuals maintained similar rates of forced smiles regardless of the age composition of groups can be interpreted as a way to keep the door open to potential benefits. If we consider that mature men generally enjoy more resources than young ones, this irregular pattern of smiling should be expected in alliance formation, as the imbalance in a potential relationship is always more detrimental for the person who has more to offer. Conversely, if smiling functioned to prevent conflicts in hierarchical situations one should have observed an *increase* in smiling in mixed-age groups, an increase particularly occasioned by young men smiling more. The actual pattern of smiling in our sample therefore supports the cooperation hypothesis.

The cooperation hypothesis also predicted that there would be no sex difference in smiling and laughter because both sexes can equally benefit from cooperative alliances. The absence of sex difference in our sample supports this prediction. It was also expected that the sex composition of groups would have an impact on smiling and laughter if these were involved in cooperation. Moreover, affiliative behaviours were expected to be linked to the proportion of same-sex individuals. As mentioned earlier in this discussion, there was no effect of sex composition of groups on smiling nor laughter. Nonetheless, male smiling and laughter were positively related to the number of males and unrelated to the number of females. The findings that men laughed more with people of their own age and that the presence of other men was more relevant to men's laughter than the presence of women suggest that laughter might be used to cement relationships between males.

The take home message of this chapter is that smiling and laughter might be more important in the regulation of intra-sexual relationships than in mate choice (perhaps with the exception of female laughter). Although the cooperation hypothesis received more support than the competition hypothesis, these two alternatives might not be as radically opposed as they first appear. In fact, the regulation of hierarchical relationships and the inhibition of conflicts are prerequisites to the creation of long-term cooperative bonds (Hand, 1986). Therefore, if smiling and laughter could promote the development of positive interactions within sexes, they might not be limited to the short-term prevention of agonistic tendencies but might extend to the formation of friendship.

Chapter Three

SMILING AND LAUGHTER IN NATURALLY OCCURRING DYADIC INTERACTIONS: RELATIONSHIP TO CONVERSATION, BODY CONTACTS, AND DISPLACEMENT ACTIVITIES

1. Introduction

Building social relationships generally entails a series of interactions during which people are able to acquire knowledge of each other. The intricate familiarity with others could facilitate attempts to control social partners and could therefore help individuals adapt their behaviour to the social environment (Dunbar, 1988). In order to achieve such a level of social expertise, people make use of a variety of information conveyed through diverse channels, including verbal exchanges, facial expressions, laughter, and body contacts (Grammer *et al.*, 1997). These different means of communication are believed to interact with each other to form a coherent system aimed at solving social issues such as mate choice (Moore, 1985; Grammer, 1989), social competition (Cashdan, 1998), or cooperation (Brown *et al.*, 2003).

The previous chapter showed that smiling and laughter could be involved in the formation of cooperative relationships. Although these behaviours were found to vary with 'demographic' factors such as group size or the age and sex of individuals involved, the previous study told us little about the mechanisms through which smiling and laughter could lead to social bonding. This question will be addressed in the next three chapters. In the present chapter, the association between smiling, laughter, aspects of conversations (talking, listening, nodding), body contacts and displacement activities will be investigated. Indeed, if smiling and laughter function to promote cooperative relationships they should be linked to a series of interpersonal factors that have been shown to positively regulate social interactions.

Displacement activities form a class of non-verbal behaviours that is widely observed in human social interactions (Morris, 1977; Eibl-Eibesfeldt, 1989). These actions involve the manipulation of objects, clothes or body parts, auto-grooming, scratching, and self-touching, to name a few. The term 'displacement activity' was first introduced by Tinbergen (1952) to describe behaviour that seemed irrelevant to the context in which they appear (see also Huxley, 1914; Tinbergen & van Iersel, 1948; Andrew, 1956). For example, pecking movements in birds can be observed before or after a sexual fight, although these actions are relevant to foraging (Tinbergen, 1952). Displacement activities are expected to occur 'when an activated motivation is denied discharge through its own consummatory act(s)' (Tinbergen, 1952, p.26). Tinbergen described two conditions in which this could happen, namely, when there is a conflict between antagonist motivations, or when stimuli responsible for the release of a behaviour are absent.

Although displacement behaviours might not have a communicative function, they are believed to reflect the state of tension or anxiety brought about by the social context (Maestripieri *et al.*, 1992). Generally speaking, social anxiety represents a condition of emotional arousal associated with the anticipation of danger (American Psychiatric Association, 1987). The ambiguity and uncertainty typical of social encounters is likely to provoke such tension. It was discussed earlier in the first chapter that non-verbal communication is complicated by two conflicting tendencies: the necessity to disclose relevant information to potential partners and the pressure imposed by social exploitation (Grammer *et al.*, 1997). This 'communication paradox' could be the main source of emotional arousal in social encounters. Interestingly, research conducted in non-human primates suggest that self-directed activities could be used as behavioural indicators of emotional state associated with social interactions (Aureli *et al.*, 1989; Aureli & van Schaik, 1991; te Boekhorst *et al.*, 1991).

There are a number of ways through which emotional arousal could be linked to social context. First, social tension could result from the uncertainty about the status relationship with the partner. For instance it has been shown that in macaques, uncertainty about the status might give way to increased rates of self-directed activities

(Schino *et al.*, 1990). Second, the perceived risk of aversive consequences might increase the frequency of displacement activities (Rowell & Hinde, 1963; Schino *et al.*, 1990). Social tension could also result from the uncertainty on how to behave next. For example, high rates of scratching were observed in male baboons during group coordination for movement (Kummer, 1968). In addition, Scucchi and colleagues (1991) observed that in opposite-sex pairs of caged long-tailed macaques, males' displacement activities increased during the periovulatory phase of the female's menstrual cycle. All in all these studies suggest that various aspects of the social context can lead to a generalized increase in individuals' arousal, which in turn is reflected in self-directed, or displacement activities.

The relationship between smiling and self-directed activities might depend on the type of smile considered and on the context in which people interact. In general, smiling could lessen arousal because it reduces the ambiguity associated with the social context. This reduction of ambiguity could probably follow the transfer, through smiling, of information associated with a particular aspect of the social situation. For example, if a particular form of smiling is aimed at reducing social tension resulting from status uncertainty and therefore helps settle the status relationship between the partners, there should be a negative relationship between that type of smile and self-directed behaviours in situations where social status matters most, i.e. in interactions between same-sex individuals. Interestingly Schino *et al.* (1990) observed that two unfamiliar macaques caged together showed decreased rates of scratching when formal indicators of status difference (such as the *silent bared-teeth* display) were exchanged. On the other hand, if a particular form of smiling helps decrease tension associated with courtship context, the relationship between self-directed activities and smiling should be negative when opposite-sex partners interact together.

It would be unreasonable to question the role of language in the development of social relationships. However the importance of verbal exchange might be dependent on its link to behaviour, as talking, laughing and smiling are often performed together as parts of a given social episode (Provine & Fischer, 1989). Considering the dynamic flow of social interactions, it has been suggested that laughter regulates conversational

behaviour (Provine, 1993; Dunbar, 1996a). Robert Provine's research underlined the importance of social context in the study of conversational laughter. He showed that the amount of laughter and the relative contribution of speaker and audience laughter depended on the sex composition of a group. For example, in most types of dyads that he surveyed, speakers were laughing more than listeners (see also Vettin & Todt, 2004). Interestingly, that pattern was reversed when the speaker was a male and the audience was female. Overall, male speakers were more efficient at eliciting audience laughter than female speakers (Provine, 1993). Two predictions can be drawn from these findings: on the one hand laughter should be mainly related to talking time; and on the other hand female laughter rate should be related to male talking time in opposite-sex pairs.

One of the functions attributed to non-verbal behaviour is the emphasis of speech and the modulation of its meaning (Argyle, 1988; Beattie, 2003). In a study investigating the connection between smiling and speech, Lee and Beattie (1998) showed that when talking about their own potential contribution to some event, people smiled more frequently while discussing the negative part of the situation than while discussing the positive part. In addition, the smiles that accompanied negative accounts appeared to be mostly Duchenne smiles. Lee and Beattie (1998) interpreted this finding as evidence that smiles operate in tandem with the verbal message, as speakers try to compensate for the negative self-construction in the speech by displaying a more positive non-verbal attitude. Smiling could therefore be used to highlight verbal utterances in a positive way.

The link between smiling and conversation could be made obvious by looking at the relationship between the duration of talking/listening bouts and smiling/laughter rates. The relationship between different forms of smiling or laughter and listening or talking time would inform us about how people use these behaviours. For instance smiling and laughter could act as reinforcers, i.e. to send non-verbal feedback to a speaker, in which case they should be positively related to listening time. On the other hand smiling and laughter could act as a speech emphasiser, i.e. to draw attention to what is said, and therefore should be related to talking time. These two regulating functions of

smiling and laughter could vary with the form and intensity of the displays and with the social context.

In addition to self-directed activities and conversational behaviour, body contacts are included in the present study in order to provide a measure of intimacy between participants. If smiling and/or laughing are involved in the process of bonding between people, they could have a particular relationship to linking behaviours such as non-aggressive body contacts. Frequent and long body contacts are assumed to reflect closeness between two persons (Morris, 1977; Argyle, 1988), and such a degree of closeness could be achieved by the use of visual or auditory signals sent at a distance. Particular forms of smiling and laughter could therefore play a role in reducing physical space between people. For example, the positive emotional experience associated with Duchenne smiles (Ekman & Friesen, 1982) could give rise to higher rates of body contacts, which would result in greater intimacy between partners. Similarly, laughing bouts could be associated with high rates of body contacts because laughter is associated with positive emotional experience (Provine, 2000; Bachorowski & Owren, 2001). In that respect, we could also observe sex differences, as males and females usually differ in their patterns of affiliative behaviours (Hall, 1984).

In the previous chapter the distinction was made between spontaneous and forced smiles. However, smiling typically involves another dimension which is mouth opening (Braningham & Humphries, 1972). As well as the classification 'spontaneous' versus 'forced', smiles will also be classified in 'open' and 'closed' smiles. Open smiles involve the showing of teeth through mouth opening whereas in closed smiles, teeth are not shown. The main reason for the inclusion of the mouth-opening dimension is that it could be affected in different ways by various aspects of the social context. Moreover, mouth opening is the feature that mainly characterises the relationship between human smiling and its non-human primate homologue, the *silent bared-teeth* display. The possibility that rates of closed and open smiles could vary according to the social context could be further evidence for a functional differentiation of the display, a trend that has already been observed in species closely related to humans (Preuschoft & van Hooff, 1997).

Overall, the main objective of this chapter is to investigate how smiling, laughter, conversation, body contacts, and self-directed behaviours relate to each other during naturally occurring dyadic interactions. This chapter also examines whether the potential associations between these variables depend on the sex composition of the dyads. Finally, the effect of age and sex on smiling and laughter rates will also be analysed. As opposed to the previous chapter that tested three hypotheses with data obtained from group interactions, the present chapter is more exploratory and does not pretend testing any specific hypothesis.

2. Method

2.1. Subjects

Most subjects were white Caucasians, and due to restriction imposed by anonymity, no systematic examination was made of background variables. Eighty four people, 41 males and 43 females, were covertly observed in naturally occurring social interactions in bars and cafes. Participants were classified into four age classes. These categories were slightly different than in chapter two, for the reason that people over 55 years old were not included in the study. Age classes were: 15-25, 25-35, 35-45, 45-55. In order to eliminate variation due to group size (see chapter two), people were observed interacting in dyads, which were subsequently classified according to the sex of individuals involved. Because only one individual was observed in each dyad, there were four types of dyads: male (focal)-male (partner), male-female, female-male, and female-female.

2.2. Procedure

People were observed from a distance of 5-20m. Individuals were selected if their face was accessible to the observer and if they were interacting in a stable pair, i.e. if no

third party came to be involved in the interaction. Interactions with passers-by were not recorded. Data were collected from September 2004 to February 2005 over a seven day week. All occurrences of the behaviours described below were sampled during focal observations performed on one individual at a time (Altmann, 1974). Duration of the samples varied from 10 to 30 minutes according to the availability of individuals. The average duration of a sample was 15.5 min (Std. Dev= 4.35). Data covered a total of 21.7 hours of observation.

2.3. Behaviours

Behaviours were classified into four different categories: *smiles*, *vocalisations*, *link*, and *displacement*. The behaviours included in those categories are described in *Table 3.1*. For a more detailed description of the different forms of smiles and laughs, see the method section in chapter 2. Behaviours were encoded in a Psion Workabout 3.1 and then transferred to the Observer 5.0 for storage and labelling. The duration of the following behaviours was recorded using the *state* function of the Observer 5.0: *talk*, *listen*, *out*, and *contact*. All the other behaviours were described as *events*.

Table 3.1. Behaviour categories and descriptions

Category	*Behaviour*	*Description*
Smile	open smile	spontaneous smile showing teeth
	closed smile	spontaneous smile without showing teeth
	forced open smile	forced smile showing teeth
	forced closed smile	forced smile without showing teeth
Vocalisation	low laughter	low intensity spontaneous laugh
	medium laughter	medium intensity spontaneous laugh
	high laughter	high intensity spontaneous laugh
	forced laughter	forced laugh
	talk	talking to the partner
	listen	listening to the partner
	out	attention directed outside the dyad
	yawn	yawning
Link	nod	head-nod
	touch	brief contact with the partner - event
	contact	long contact with the partner - state
	kiss lip	kissing partner's lips
	kiss head	kissing partner's head
	kiss body	kissing partner's body
Displacement	auto-face	fiddling or self-grooming in the face area
	auto-hair	fiddling or self-grooming one's hair
	auto-hand	fiddling or self-grooming one's hands
	object	fiddling with an object or with clothes
	adjust	adjust one's hair or clothes

2.4. Data analysis

Observer spreadsheets were transferred to SPSS for statistical analysis. All *event* behaviours were transformed into rate per minute by dividing the total frequency by total observation time whereas *state* behaviours such as talking and listening were converted into percentages of the total observation time. All displacement activities

were added together to form a single index (also expressed in rate per minute) representing the arousal brought about by the social context. Due to the small observed frequency of body contacts between participants, people were classified in two groups according to their involvement in body contacts: contact or no contact.

Stepwise regression analyses focussed on the effect of several variables on smiling and laughter rates. Because different forms of smiles could be affected in a different way, each dimension of smiling was the object of a separate analysis. It is important to note that smile categories are not exclusive of each other. Rather, I retained two dimensions on which smiles vary: spontaneity and mouth opening. Therefore the analysis of one aspect of a dimension involves both aspects of the other dimension. For example, the analysis of spontaneous (or forced) smiles includes both open and closed smiles, while the analysis of open (or closed) smiles includes both spontaneous and forced smiles. The independent variables were: the sex and age of the focal individual, the sex and age of the interacting partner, head-nods (rate per min.), self-directed behaviours (rate per min.), laughter (rate per min.), talking and listening time (percentage of the observation period spent talking/listening).

In order to analyse the effect of independent variables in more details, i.e. to reveal possible interaction effects between variables, multivariate analyses were performed on each category of smile type. Whenever a category of smile was related to the other, it was introduced in the model as a covariate so that its relative impact was statistically controlled. Results relative to smiling and laughter are presented separately.

3. Results

3.1. Smiling

Correlation analysis was performed to assess the relationships between the variables under study (*Table 3.2*). Each type of smile was then treated as a dependent variable in

a regression analysis. Each analysis yielded a significant model, but the number and type of predictors emerging as significant varied with the type of smile considered (*Table 3.3.*).

Table 3.2. Correlations between spontaneous smile (sps), forced smile (fs), open smile (os), closed smile (cs), laughter (lau), headnods (hn), talking (talk), listening (list), and displacement activities (displ). All variables are expressed in rate per min., except talking and listening time that represented percentage of total observation time spent talking/listening. $^{*}p<.05$, $^{**}p<.01$

	sps	*fs*	*os*	*cs*	*lau*	*hn*	*talk*	*list*	*displ*
sps		.02	.80**	.49**	.58**	-.08	.22*	.05	.07
fs			.08	.23*	-.01	.22*	-.07	.38**	-.25*
os				-.09	.47**	-.09	.14	.06	.09
cs					.28*	.07	.13	.11	-.09
lau						-.04	.87	.17	.07
hn							-.17	.57**	-.19
talk								-.48**	.05
list									-.05
displ									

Table 3.3. Summary of stepwise regression analyses performed on the different types of smiles (rates per min.). Predictors are: sex (sex foc, 0: male, 1:female), and age (age foc) of focal individual, sex and age of interacting partner, head-nod (rate per min.), laughter (rate per min.), displacement activities (displ.act., rate per min.), talking and listening time (% of total observation time). Key: [a]Dependent variables, $^{*}p<.05$, $^{**}p<.01$, $df = 83$

Smile type[a]	*F*	R^2_{adj}	*Predictors*	*B*	*SE B*	*β*	*t*
Spontaneous	19.02**	.39	(constant)	1.80	0.33		5.41**
			laughter	0.27	0.45	.52	5.93**
			age foc	-0.20	0.08	-.22	-2.55**
			talking	0.01	0.01	.18	2.05*
Forced	9.85**	.18	(constant)	0.09	0.05		1.89
			listening	0.01	0.01	.37	3.69**
			displ.act.	-0.4	0.02	-.23	-2.27*
Open	17.72**	.29	(constant)	1.76	0.24		7.23**
			laughter	0.18	0.43	.41	4.28**
			age foc	-0.24	0.75	-.30	-3.13**
Closed	9.28**	.17	(constant)	0.91	0.08		10.84**
			sex foc	-0.32	0.10	-.33	-3.30**
			laughter	0.09	0.03	.28	2.83**

Spontaneous smile rate was significantly affected by laughter rate, age of focal individual, and talking time (*Figure 3.1a*). Laughter rate and talking time had a positive relationship to spontaneous smile rate whereas the age of focal was negatively related to spontaneous smiles, indicating that smile rate tended to decrease as age increased.

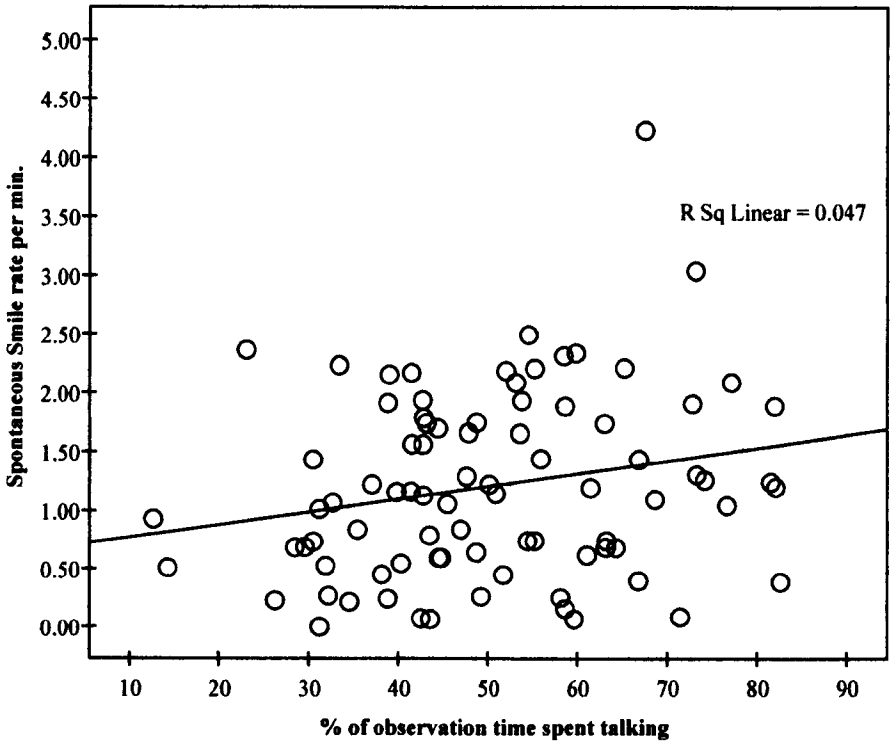


Figure 3.1a. Relationship between spontaneous smile and talking time.

The rate of forced smile was positively related to listening time (*Figure 3.2b*) but not talking time (*Figure 3.2a*). On the other hand there was a negative relationship between forced smile rate and the frequency of displacement activities (*Figure 3.3*).

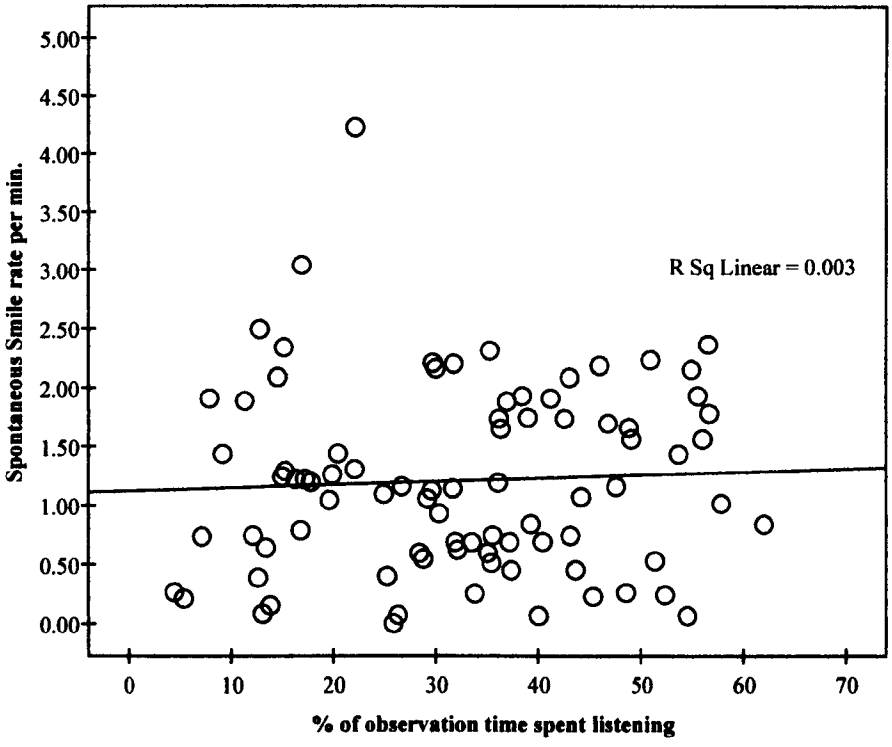


Figure 3.1b. Relationship between spontaneous smile and listening time.

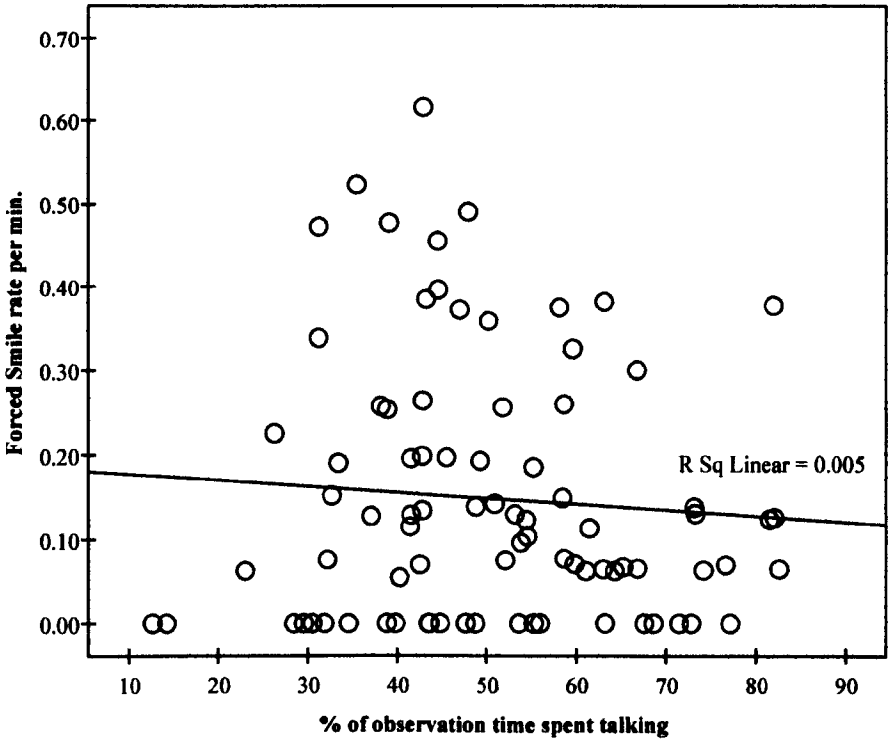


Figure 3.2a. Relationship between forced smile and talking time

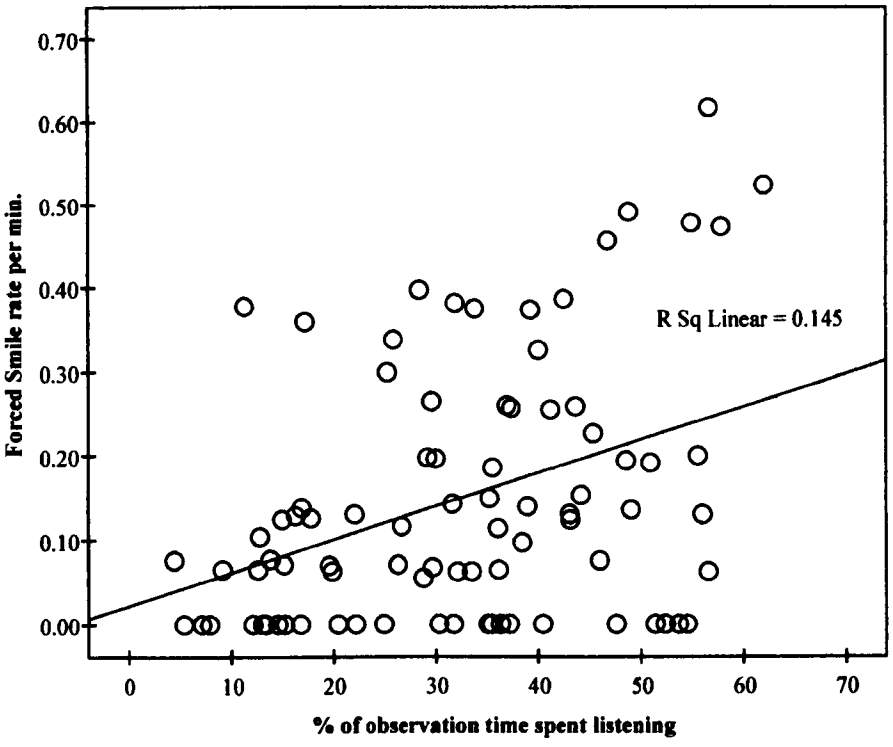


Figure 3.2b. Relationship between forced smile and listening time

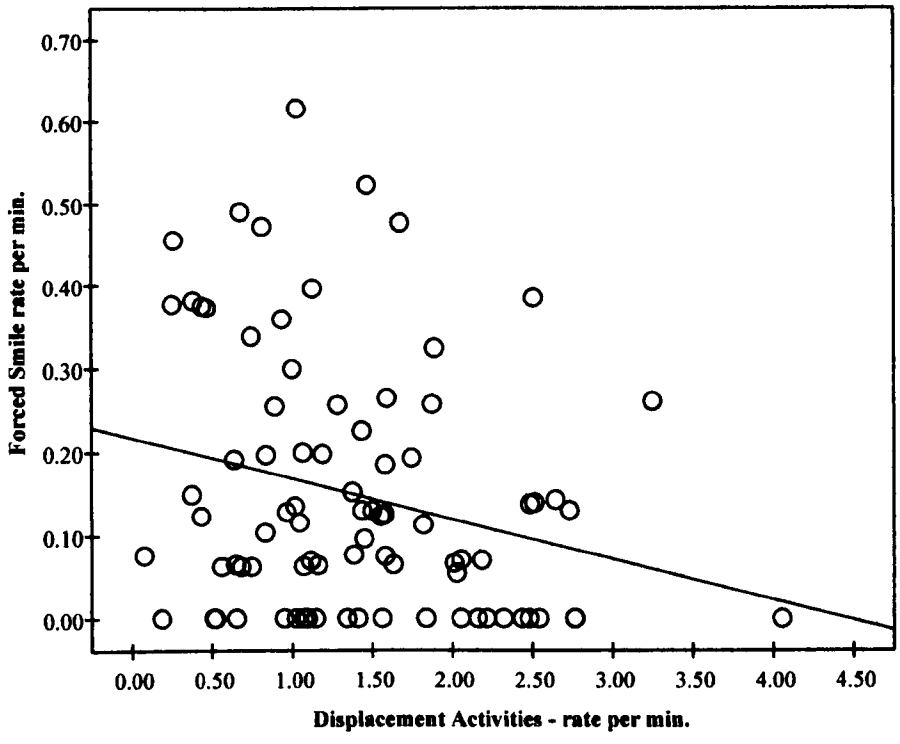


Figure 3.3. Relationship between forced smile and displacement activities.

Open and closed smiles were both significantly and positively related to laughter rate. However these two forms of smiling were affected in a different way by the sex and age of individuals (*Table 3.3*). The frequency of open smile was negatively related to individual's age suggesting that it decreases as people go older. On the other hand closed smile rate was influenced by individuals' sex, and men showed significantly more closed smiles than women did.

3.2. Smile Type and Sex Composition of Dyads

This section investigates the effect of independent variables on the different types of smile in relation to the sex composition of dyads. The analysis was split into four categories according to the sex of the focal individual and the sex of interacting partner: male–male, male–female, female–male, female–female. Correlations between variables are presented in *Table 3.4* (*a, b, c, d*).

Table 3.4a. Correlations in all-male dyads between spontaneous smile (sps), forced smile (fs), open smile (os), closed smile (cs), laughter (lau), headnods (hn), talking (talk), listening (list), and displacement activities (displ). All variables are expressed in rate per min., except talking and listening time that represented percentages of total observation time spent talking/listening. $^{*}p<.05$, $^{**}p<.01$

male-male	*sps*	*fs*	*os*	*cs*	*lau*	*hn*	*talk*	*list*	*displ*
sps		-.05	.64**	.74**	.63**	-.23	.16	-.04	.04
fs			-.02	.16	-.35	.34	-.18	.54**	-.27
os				-.02	.38	-.38	.14	-.23	.21
cs					.42*	.09	.05	.25	-.18
lau						-.27	.30	.11	.18
hn							.17	.36	-.18
talk								-.36	.12
list									-.19

Table 3.4b. Correlations in male-female dyads. $^{*}p<.05$, $^{**}p<.01$

male-female	*sps*	*fs*	*os*	*cs*	*lau*	*hn*	*talk*	*list*	*displ*
sps		-.32	.90**	.27	.54*	.04	.24	-.05	.01
fs			-.32	.25	-.24	-.03	-.16	.01	-.07
os				-.15	.42	-.05	.21	-.17	-.01
cs					.26	.19	-.15	.24	.01
lau						.07	-.02	.06	.08
hn							-.43	.78**	-.01
talk								-.72**	-.19
list									.07

Table 3.4c. Correlations in all-females dyads. $^{*}p<.05$, $^{**}p<.01$

female-female	*sps*	*fs*	*os*	*cs*	*lau*	*hn*	*talk*	*list*	*displ*
sps		-.11	.81**	.40	.51*	-.16	.22	.04	.31
fs			-.01	.19	.11	-.05	-.09	.33	-.45*
os				-.17	.51*	-.19	.17	.04	.32
cs					.13	-.01	.07	.13	-.12
lau						-.05	.25	.02	.38
hn							-.35	.68**	.13
talk								-.52*	-.06
list									.24

Table 3.4d. Correlations in female-male dyads. $^{(*)}p<.06$ $^{*}p<.05$, $^{**}p<.01$

female-male	*sps*	*fs*	*os*	*cs*	*lau*	*hn*	*talk*	*list*	*displ*
sps		.45*	.95**	.34	.67**	.17	-.01	.36	-.17
fs			.49*	.60**	.23	.48*	.07	.60**	-.26
os				.11	.61*	.11	.07	.37	-.08
cs					.26	.48*	-.14	.37	-.41(*)
lau						.16	-.19	.38	-.33
hn							-.28	.65**	-.35
talk								-.30	.16
list									-.26

Results of the stepwise regression analyses are presented in *Table 3.5*. These suggest that spontaneous and open smiles presented similar patterns of association with the independent variables. However spontaneous smile was the only type that was invariably related to laughter rate across all dyads. Interestingly, age and talking time had a significant impact on spontaneous and open smile rates only when males were observed interacting with females.

Table 3.5. Summary of stepwise regression analyses performed on the different categories of smile (rate per min.). Predictors are: age of focal individual (age foc), age of interacting partner, head-nod (rate per min.), laughter (overall rate per min.), displacement activities (rate per min., displ. act.), talking and listening time (% of total observation time). Key: [a]Focal individual-Interacting partner. [b]Dependent variable. $^{*}p<.05$, $^{**}p<.01$

Dyad Type[a]	*Spontaneous Smiles*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	13.21**	.37	21	(constant)	1.8	1.8		10.12**
				laughter	0.32	0.09	.63	3.63**
Male-Female	8.12**	.54	18	(constant)	2.86	0.76		3.77**
				laughter	0.32	0.11	.48	2.98**
				age foc	-0.61	0.19	-.54	-3.25**
				talking	0.02	0.01	.37	2.28*
Female-Male	16.24**	.42	21	(constant)	1.42	0.15		9.38**
				laughter	0.25	0.06	.67	4.03**
Female-Female	6.76*	.22	20	(constant)	1.59	0.18		8.83**
				laughter	0.28	0.11	.51	2.60*
Dyad Type[a]	*Forced Smiles*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	8.12**	.40	21	(constant)	-0.05	0.06		-0.94
				listening	0.01	0.00	.58	3.45**
				laughter	-0.03	0.01	-.41	-2.44*
Male-Female	0.27	.15	18					
Female-Male	11.51**	.33	21	(constant)	-0.1	0.08		-1.19
				listening	0.01	0.00	.60	3.39**
Female-Female	7.27**	.48	20	(constant)	-0.04	0.1		-0.42
				listening	0.01	0.00	.84	3.75**
				displ. act.	-0.12	0.03	-.57	-3.47**
				head-nod	-0.09	0.03	-.56	-2.53*
Dyad Type[a]	*Open Smiles*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	0.80	.29	21					
Male-Female	9.69**	.59	18	(constant)	2.23	0.66		3.37**
				age foc	-0.67	0.16	-.64	-4.09**
				talking	0.02	0.01	.47	3.01**
				laughter	0.22	0.09	.35	2.33*
Female-Male	11.63**	.22	21	(constant)	1.21	0.17		7.15**
				laughter	0.24	0.07	.61	3.41**
Female-Female	6.64*	.37	20	(constant)	1.11	0.16		6.79**
				laughter	0.25	0.10	.51	2.58*
Dyad Type[a]	*Closed Smiles*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	1.07	.02	21					
Male-Female	0.26	-.40	18					
Female-Male	5.91*	.19	21	(constant)	0.42	0.06		6.86**
				head-nod	0.10	0.04	.48	2.43*
Female-Female	1.05	.02	20					

It was mentioned earlier in this section that forced smiles were mainly related to listening time. *Table 3.5.* shows that it was the case for most dyads except those in which men were interacting with women. In addition the present analysis shows that the negative relationship between forced smiles and displacement activities was present in all-female dyads. Besides, the only instance in which forced smile rate was associated with laughter rate was in all-male dyads and it was with a negative relationship. Finally, closed smile rate was only related to head-nod rate in female–male dyads.

Regression analyses suggest that smiling was affected in a different way by the social context, i.e. the sex composition of dyads as well as the age of individuals involved. Subsequent analyses were conducted in order to investigate these effects in more details and to reveal possible interaction effects. A 2 × 2 × 2 × 2 univariate analysis of variance with sex and age[3] of individuals as between-subject factors was performed on the different types of smiles. Although there was no main effect of sex alone on spontaneous smile (rate per min.), the interaction between sex of focal and sex of partner was significant, $F(1, 83) = 4.46$, $p = .04$. A separate analysis showed that men tended to receive more spontaneous smiles from other men ($M = 1.38$, $SD = 0.79$, $n = 22$) than from women ($M = 1$, $SD = 0.68$, $n = 22$), $F(1, 41) = 3.64$, $p = .06$, $d = 0.51$, whereas women received equal amounts of smiles from men and women, $F(1, 37) = 0.24$, $p = .63$ (*Figure 3.4*).

[3] In the subsequent univariate analyses, age categories were lumped in two classes: young (<35 years old) and mature (>35 years old).

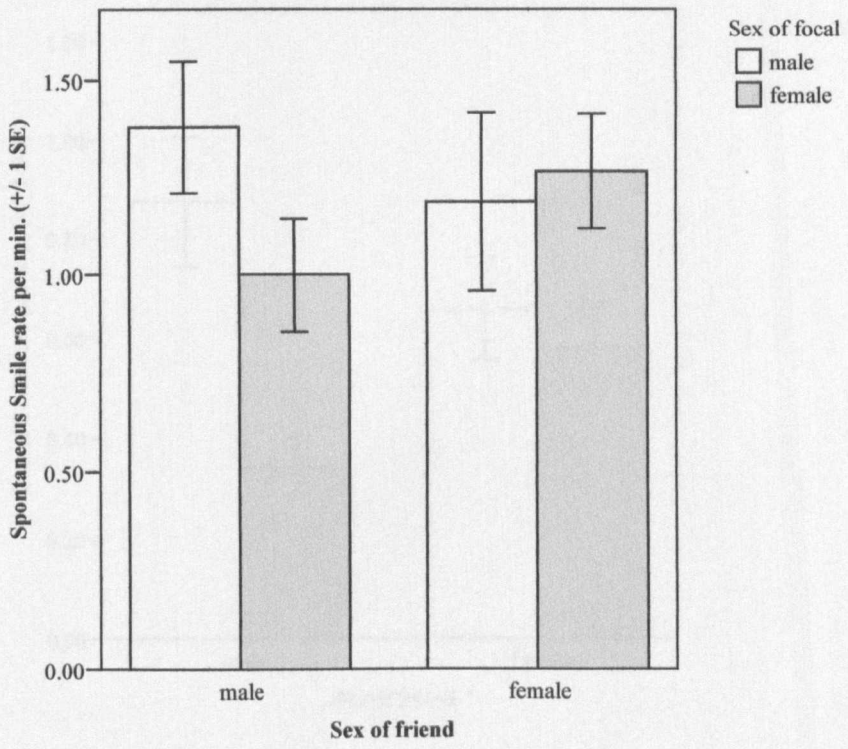


Figure 3.4. Effect of sex composition of dyads on spontaneous smile (mean rate per min.).

As presented earlier in this section, the frequency of closed smiles seemed to be affected by the sex of focal individual (*Table 3.3*). Univariate analysis confirmed that men displayed significantly higher rates of closed smiles than women, $F(1, 83) = 4.11$, $p = .047$. Furthermore there was a significant interaction effect between sex of focal and sex of partner on closed smiles (rate per min.), $F(1, 83) = 12.04$, $p = .001$, indicating that the sex difference was mediated by the sex of the interacting partner. Separate analyses revealed that when interacting with other men, men showed significantly higher rates of closed smiles ($M = 0.87$, $SD = 0.62$) than women ($M = 0.34$, $SD = 0.27$), $F(1, 35) = 12.21$, $p = .001$, $d = 1.11$, whereas this sex difference was absent when the partner was a woman, $F(1, 31) = 1.32$, $p = .26$. A different way of interpreting that interaction is that women gave more closed smiles to other women ($M = 0.58$, $SD = 0.40$, $n = 21$) than to men ($M = 0.34$, $SD = 0.27$, $n = 21$), $F(1, 34) = 24.48$, $p < .001$, $d = 0.69$. These results are illustrated in *Figure 3.5*.

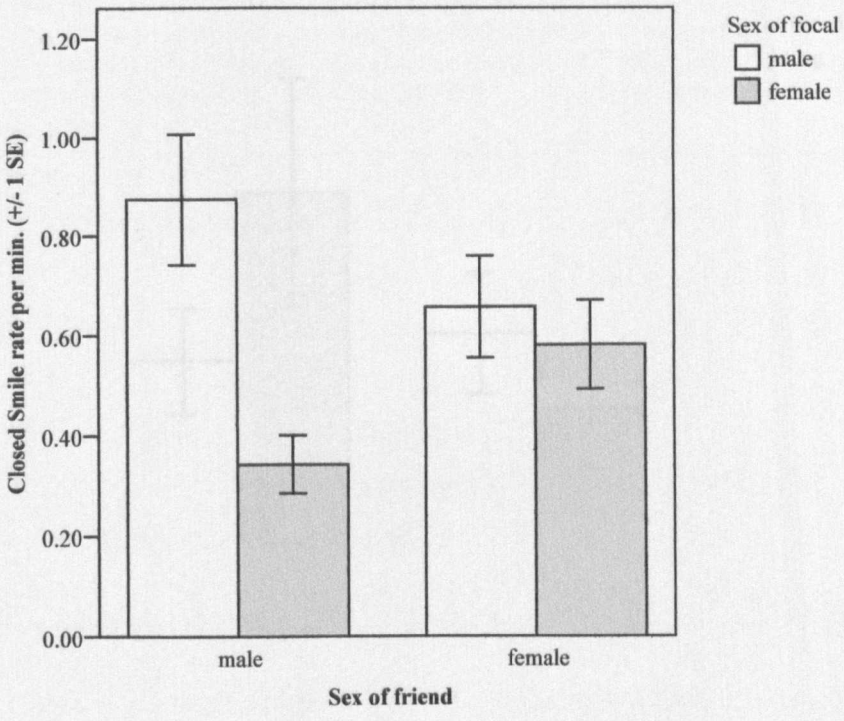


Figure 3.5. Effect of sex composition of dyads on closed smile (rate per min.).

The same analysis was performed on forced smiles (rate per min.) and revealed a significant interaction between sex and age of interacting partner, $F(1, 83) = 5.19$, $p = .03$, suggesting that the effect of partner's sex depended on his age and was observed in mature adults only. On average, mature men received significantly more forced smiles ($M = 0.22$, $SD = 0.20$, $n = 12$) than mature women ($M = 0.11$, $SD = 0.12$, $n = 14$), $F(1, 26) = 5.26$, $p = .03$, $d = 0.67$, whereas young men and women received equal amounts of forced smiles, $F(1, 49) = 0.72$, $p = .40$ (*Figure 3.6*). Alternatively, the interaction effect pointed out that when the interacting partner was a man, mature individuals appeared to received more forced smiles ($M = 0.22$, $SD = 0.20$, $n = 11$) than younger ones ($M = 0.14$, $SD = 0.15$, $n = 32$), $F(1, 35) = 3.73$, $p = .06$, $d = 0.48$, whereas this effect was non-significant when the friend was a woman, $F(1, 31) = 1.64$, $p = .21$ (*Figure 3.6*).

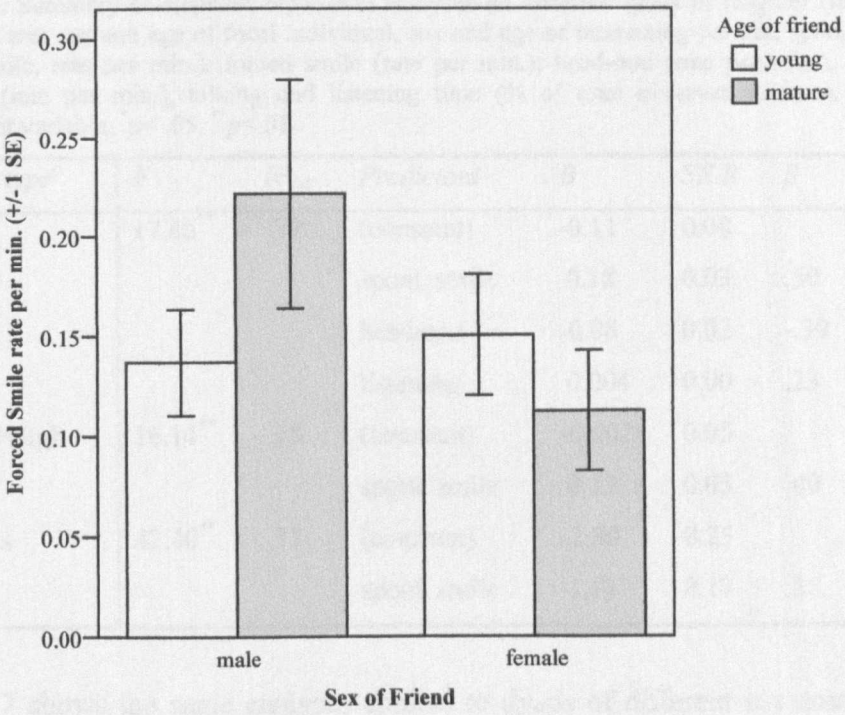


Figure 3.6. Effect of sex and age of interacting partner on forced smile (mean rate per min.). Age classes are: young (<35 years old) and mature (> 35 years old).

3.3. Laughter

In order to facilitate statistical analysis, laughter of medium and high intensities were grouped in one category. Laughter of low and high intensities were then analysed separately. Regression analyses showed that spontaneous smile (rate per min.) was the most significant predictor and was positively associated with all types of laughter, regardless of intensity (*Table 3.6*). In addition, low intensity laughter (rate per min.) was positively related to listening time but negatively related to head-nod (rate per min.).

Table 3.6. Summary of stepwise regression analyses on different types of laughter (rate per min.). Predictors are: sex and age of focal individual, sex and age of interacting partner, spontaneous smile (spont. smile, rate per min.), forced smile (rate per min.), head-nod (rate per min.), displacement activities (rate per min.), talking and listening time (% of total observation time), df=83. Key: [a]Dependent variable. $^{*}p< .05$, $^{**}p<.01$

Laughter type[a]	*F*	R^2_{adj}	*Predictors*	*B*	*SE B*	*β*	*t*
Low	17.46**	.39	(constant)	-0.11	0.08		-1.33
			spont. smile	0.18	0.03	.50	5.67**
			head-nod	-0.08	0.02	-.39	-3.71**
			listening	0.004	0.00	.23	2.13*
Medium+High	16.14**	.15	(constant)	-0.002	0.05		-0.04
			spont. smile	0.13	0.03	.40	4.02**
All laughs	42.40**	.33	(constant)	-2.80	0.25		-11.20**
			spont. smile	1.13	0.17	.58	6.51**

Table 3.7 shows the same analyses applied to dyads of different sex composition. It indicates that low intensity laughter was positively affected by conversation aspects in male–male dyads only. Besides, forced smile and head-nod rates had a significantly negative impact on low laughter rate in all-male pairs. Laughs of high intensity in all-male pairs could not be predicted by the model.

Interestingly, laughs of high intensity were affected by spontaneous smile in mixed-sex dyads but not in single-sex dyads. In all-female pairs, displacement activities were positively associated with laughs of high intensity.

Table 3.7. Summary of stepwise regression analyses on different types of laughter (rate per min.). Predictors are: age of focal individual, age of interacting partner, spontaneous smile (rate per min., spont. smile), forced smile (rate per min., f. smile), head-nod (rate per min.), displacement activities (rate per min., displ. act.), talking and listening time (% of total observation time). Key: [a]Focal individual-Interacting partner,[b]Dependent variables, $^{*}p<.05$, $^{**}p<.01$

Dyad Type[a]	*Low laughs*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	26.53**	.86	21	(constant)	-0.77	0.17		-4.58**
				spont. smile	0.17	0.03	.45	5.10**
				head-nod	-0.11	0.02	-.69	-6.91**
				talking	0.01	0.002	.42	4.31**
				listening	0.01	0.003	.47	4.34**
				f. smile	-0.58	0.23	-.25	-2.50*
Male-Female	4.73*	.17	18	(constant)	0.14	0.07		2.02*
				spont. smile	0.10	0.04	.47	2.17*
Female-Male	10.91**	.32	21	(constant)	0.02	0.09		0.16
				spont. smile	0.26	0.08	.59	3.30**
Female-Female	5.97*	.20	20	(constant)	0.06	0.14		0.44
				spont. Smile	0.23	0.09	.49	2.44*
Dyad Type[a]	*Med+High laughs*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	0.83	-.07	21					
Male-Female	10.56**	.35	18	(constant)	-0.01	0.04		-0.22
				spont. smile	0.09	0.03	.62	3.25**
Female-Male	18.02**	.45	21	(constant)	-0.15	0.10		-1.53
				spont. smile	0.35	0.08	.69	4.24**
Female-Female	8.93**	.28	20	(constant)	-0.09	0.09		-0.96
				displ. act.	0.17	0.06	.56	2.99**
Dyad Type[a]	*All laughs*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	7.91**	.40	21	(constant)	-0.03	0.17		0.21
				spont. smile	0.29	0.11	.46	2.62*
				head-nod	-0.11	0.05	-.40	-2.31*
Male-Female	12.84**	.40	18	(constant)	0.13	0.08		1.56
				spont. smile	0.19	0.05	.66	3.58**
Female-Male	25.35**	.54	21	(constant)	-0.13	0.14		-0.93
				spont. smile	0.61	0.12	.74	5.03**
Female-Female	6.05*	.20	20	(constant)	0.13	0.18		0.71
				spont. smile	0.30	0.12	.49	2.46*

3.4. Smiling, Laughter, and Conversation

Although listening and talking time were positively related to low intensity laughter in male–male pairs only (*Table 3.7*), neither talking nor listening time could significantly predict overall laughter rates (*Table 3.6*). Further analyses were conducted to test whether laughter and smiling rate could predict talking or listening time. *Table 3.8*

indicates that the behaviours under study poorly predicted talking time. On the other hand, listening time was significantly affected by non-verbal behaviour, forced smiles and head-nods in particular. Interestingly, laughs at high intensities, but not low intensity laughs, had a significantly positive impact on listening time in women (*Figure 3.7*). This seemed to be particularly the case when women were interacting in mixed-sex dyads (*Table 3.8*). This suggests that the more women were laughing the more they elicited speech in their male partners, only if their laughs were of high intensities.

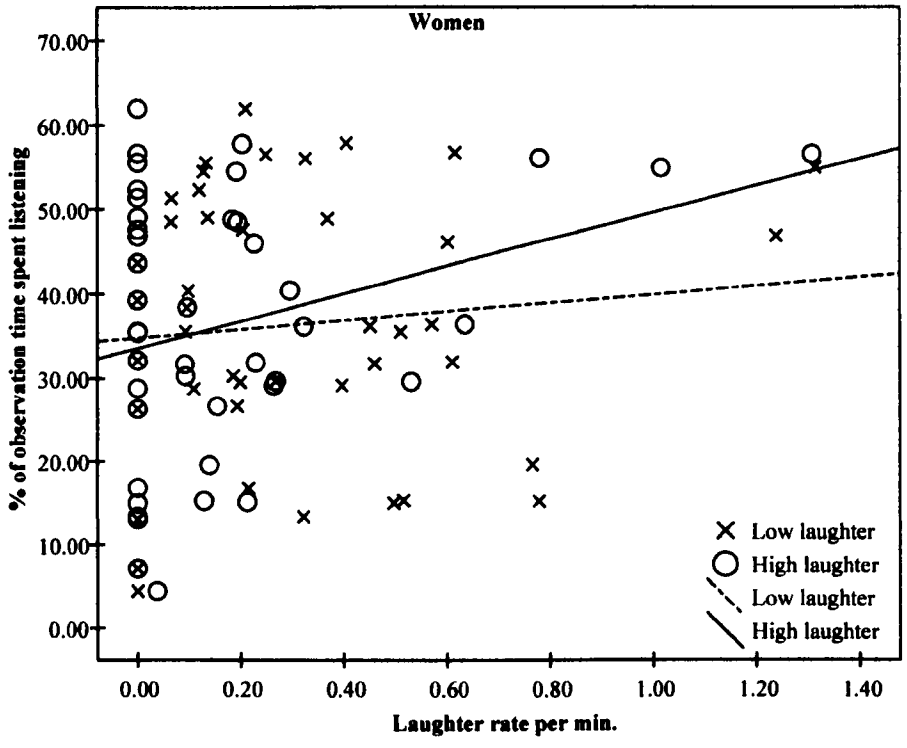


Figure 3.7. Relationship between the different intensities of laughter and listening time in **women.**

Table 3.8. Summary of stepwise regression analyses on different aspects of conversation (percentage of observation time. Predictors are: age of focal individual, age of interacting partner (age part), spontaneous smile (rate per min.), forced smile (rate per min., f. smile), low and high intensity laughter (l. laugh and h. laugh: rate per min.), head-nod (rate per min.), displacement activities (rate per min., displ.act.). Key: [a]Focal individual-Interacting partner, [b]Dependent variable, $^{*}p<.05$ $^{**}p<.01$

Dyad type[a]	*Talking*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	1.25	.09	21					
Male-Female	1.40	.15	18					
Female-Male	1.11	.04	21					
Female-Female	5.88**	.33	20	(constant)	72.37	8.48		8.54**
				age part	-7.30	2.56	-.53	-2.85*
				head-nod	-5.73	2.61	-.41	-2.20*
Dyad type[a]	*Listening*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	9.54**	.45	21	(constant)	-1.51	7.98		-0.19
				age part	7.47	2.65	.47	2.82**
				f. smile	40.61	15.71	.43	2.58*
Male-Female	26.45**	.59	18	(constant)	35.81	2.52		14.19**
				head-nod	11.05	2.15	.78	5.14**
Female-Male	11.94**	.51	21	(constant)	37.60	3.29		11.43**
				head-nod	7.84	1.96	.61	4.00**
				h. laugh	17.39	7.27	.37	2.39*
Female-Female	14.59**	.67	20	(constant)	22.60	5.89		3.84**
				f. smile	54.37	14.48	.54	3.75**
				head-nod	10.34	2.02	.66	5.12**
				displ. act.	8.04	2.97	.39	2.71*
Dyad type[a]	*Time out*[b]							
	F	R^2_{adj}	*df*	*Predictors*	*B*	*SE B*	*β*	*t*
Male-Male	14.42**	.66	21	(constant)	23.08	4.20		5.49**
				head-nod	-7.23	1.30	-.94	-5.56**
				l. laugh	-37.51	7.97	-.79	-4.71**
				f. smile	-36.36	15.31	-.33	-2.37*
Male-Female	1.81	.26	18					
Female-Male	10.10**	.30	21	(constant)	30.96	3.86		8.01**
				f. smile	-48.33	15.21	-.58	-3.18**
Female-Female	13.04**	.55	20	(constant)	-3.51	3.13		-1.12
				head-nod	-3.50	0.96	-.55	-3.64**
				age part	3.01	0.95	.48	3.18**

3.5. Smiling, Laughter, and Body Contacts

The overall rate of body contacts did not have the properties needed to perform parametric statistical tests. People were therefore classified into two groups according

to their involvement in body contacts (contact or no contact). A Student *t*-test was conducted to estimate whether these two groups differed with respect to smiling and laughter rate. Data were split according to the sex of individuals.

Analysis showed that the association between smiling and body contacts depended on the type of smile considered and the sex of people involved. There was a significant difference in open smile rates between contact and no-contact individuals in women, $t = -2.18$, $p = .03$, but not in men, $t = -0.19$, $p = .85$, indicating that women who had at least one body contact with their partner exhibited higher rates of open smiles ($M = 1.16$, $SD = 0.61$, $n = 12$) than women who showed no contact ($M = 0.69$, $SD = 0.64$, $n = 31$), $d = 0.75$. The sex difference within the 'contact' category was also significant, $t = -2.19$, $p = .04$, indicating that women showed higher rates of open smiles ($M = 1.16$, $SD = 0.61$, $n = 12$) than men ($M = 0.71$, $SD = 0.31$, $n = 9$), $d = 0.92$ when they had at least one physical contact with their friend (*Figure 3.8*).

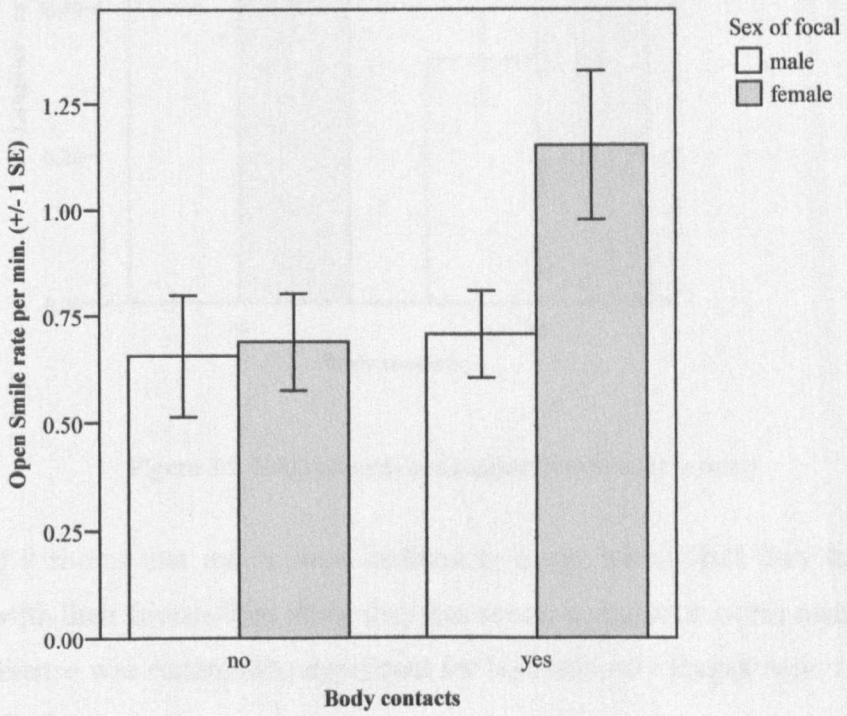


Figure 3.8. Body contacts and open smiles (mean rate per min.) in men and women. The contact category includes pairs for which at least one body contact has been observed.

Laughter rates were related to body contacts in a similar way than open smiles were. Women who had at least one physical contact with their friend displayed significantly higher rates of laughter (of any type) ($M = 0.61$, $SD = 0.4$) than women who had no contact ($M = 0.45$, $SD = 0.51$), $t = -2.83$, $p = .007$, $d = 0.35$. However, this was not the case for men $t = -0.80$, $p = .43$. The sex difference within the contact category was marginally significant $t = -2.02$, $p = .058$, suggesting that women who had physical contacts with their friends laughed at higher frequencies ($M = 0.61$, $SD = 0.4$) than men did ($M = 0.33$, $SD = 0.19$), $d = 0.88$. (see *Figure 3.9*).

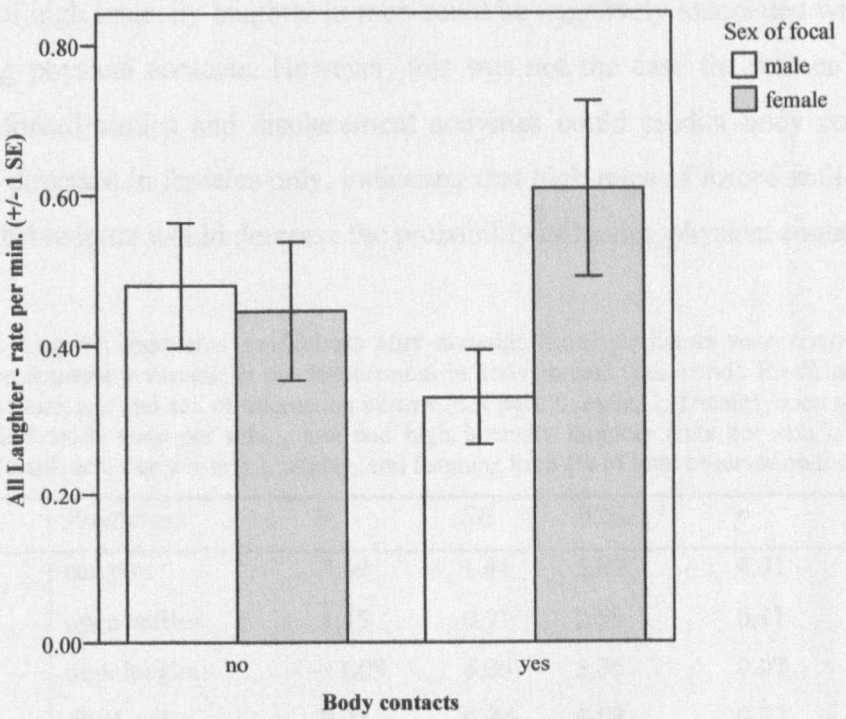


Figure 3.9. Body contacts and laughter (mean rate per min.).

Figure 3.9 shows that males were inclined to laugh more when they had no body contact with their friends than when they had some. It might be worth mentioning that this difference was statistically significant for high intensity laughs only, $t = 2.45$, $p = .02$, $d = 0.66$.

A logistic regression was performed in order to estimate the impact of smiling and laughter on the probability to have at least one physical contact during the interaction.

Data were analysed separately for each sex. The model was significant (men: χ^2 = 15.21, p = .01; women: χ^2 = 22.82, p < .001; df = 5), and accounted for between 31% and 48.6% of the variance in men, and between 41.2% and 59.3% of the variance in women. Overall, the accuracy of predictions was 87.8% for males and 81.4% for females. Results of the logistic regression are presented in *Table 3.9* and showed that the sex of the partner reliably predicted body contacts in men and women, with a higher probability of having physical contacts when interacting with opposite-sex friends. In addition, open smile rates could reliably predict body contacts in women but not in men. The analysis also showed a marginally significant trend suggesting that the amount of high intensity laughter in men could be negatively associated with the odds of having physical contacts. However, this was not the case for women's laughter. Finally, forced smiles and displacement activities could predict body contacts in a negative direction in females only, indicating that high rates of forced smiles and self-directed behaviours would decrease the probability of having physical contact.

Table 3.9. Logistic regression coefficients after non-significant predictors were removed from the model. The dependent variable is the involvement in body contact (yes or no). Predictors are: age of focal individual, age and sex of interacting partner (sex part: 0: male, 1: female), open smile (rate per min.), forced smile (rate per min.), low and high intensity laughter (rate per min.), displacement activities (displ. act., rate per min.), talking, and listening time (% of total observation time).

	Predictors	*B*	*SE*	*Wald* χ^2	*p*	*EXP (B)*
Males	sex part	3.49	1.44	5.87	0.01	32.73
n = 41	open smiles	1.45	0.91	2.55	0.11	4.25
	high laughs	-11.09	6.06	3.35	0.07	0.00
	displ. act.	0.25	0.88	0.08	0.77	1.29
	forced smiles	4.11	4.19	0.96	0.33	60.96
	(constant)	-4.69	2.33	4.07	0.04	0.01
Females	sex part	-4.13	1.63	6.43	0.01	0.02
n = 43	open smiles	4.38	1.78	6.07	0.01	79.93
	high laughs	-0.50	2.27	0.05	0.83	0.61
	displ. act.	-1.88	0.97	3.77	0.05	0.15
	forced smiles	-11.64	4.83	5.80	0.02	0.00
	(constant)	0.92	1.32	0.49	0.49	2.52

4. Discussion

The main objective of this chapter was to investigate how smiling, laughter, conversations, body contacts, and self-directed behaviours relate to each other during naturally occurring interactions. Data showed that smiling and laughter rates were connected to the other behaviours under study, and that these relationships varied, on the one hand, with the type of smiling and laughter considered, and on the other hand, with the social context. The discussion will try to make sense of these data in terms of how smiling and laughter could contribute to the development of social relationships and lead to bonding.

Spontaneous smile was the only smile type that was invariably associated with laughter rate, regardless of the sex composition of the dyads. The overlap between spontaneous smile and laughter suggests that this form of smile (and to some extent open smile) might share a similar motivational basis with laughter. This finding supports previous studies reporting associations between spontaneous smiles and laughter (Ruch, 1994) and it also shows that these behaviours frequently co-occur in naturally ongoing interactions.

The early proposal made by van Hooff (1972) that smiling and laughter have different motivational roots and converged during evolutionary times is also supported. On the one hand, the fact that forced and closed smiles were unrelated to laughter and hence seemed to occur in different contexts implies that they have a different function and therefore might have a different evolutionary history. On the other hand, the association between spontaneous and open smiles and laughter suggests that it is these two dimensions that might have converged with laughter as a result of their occurrence in similar situations. The reason for the separation, or the overlap, between certain forms of smiling and laughter probably lies behind characteristics of the social context in which interactions occur.

The only association between forced smile rate and laughter was a negative relationship, and it was exclusively observed in all-male pairs. This finding indicates

that the separation between forced smiles and laughter could be particularly meaningful in relationships between men. The fact that mature males received considerably more forced smiles than young males and mature females implies that forced smiles could display a submissive position, as older men usually enjoy higher social status. In that sense, the forced smile might have conserved the original meaning of the *silent bared-teeth* display (see *chapter 2*), and this position could be at odds with the playful attitude manifest in laughter. More generally forced smiles could be involved in the communication of friendly, polite, and formal agreement.

In an interesting essay on the link between smiling and laughter, van Hooff and Preuschoft (2003) suggested that this link could depend on the type of relationship between sender and receiver. These authors claimed that under conditions of hierarchical and strongly asymmetrical relationships between individuals there would be distinct signals communicating submission and appeasement, affiliation, and playfulness; whereas in egalitarian relationships the same displays would be used to communicate submission, affiliation, appeasement and play. They called this claim the power asymmetry hypothesis, which construes that the type of social organisation shapes the meaning of displays (Preuschoft & van Hooff, 1997; van Hooff & Preuschoft, 2003). The present data give indirect support to the power asymmetry hypothesis in that forced smiles in male relationships were inversely related to laughter. This suggests that when relationships are potentially hierarchical the occurrence of forced smiling is distinct from that of laughter (see also appendix one).

Frequencies of deliberate smiles did negatively correlate with displacement activities, and this was particularly the case in all-female dyads. It appeared that when interacting with other women, female individuals who displayed increased rates of forced smile did also show little self-directed behaviours. This suggests that women who were feeling at ease with the situation (as expressed by low rates of displacement acts) were also inclined to show higher frequencies of forced smile. Alternatively, it is possible that the frequency of forced smiles in women is associated with a reduction of conflict between motivational states that are usually at the root of displacement activities (Tinbergen, 1952). This reduction of conflict or tension could have resulted from

detailed aspects of the conversation not available to us at the time the study was conducted. Another way of looking at it would be that a greater control over social behaviour (evidenced by increased rates of forced smiles) might have decreased tension induced by the social context. Therefore when interacting with other women, women could be able to regulate emotional aspects of social interaction by a better control over their social behaviour.

Parallels can be drawn between this result and findings from studies on non-human primates that reported decreased rates of scratching in caged macaques after the display of formal signs of status (Schino *et al.*, 1990). Although we had only indirect access to the behaviour of the interacting partner, deliberate smiling between females might have instilled a friendly, or relaxed atmosphere which in turn affected their perception of the social context. Forced smiles could therefore lessen the social tension present in female relationships, suggesting that it could communicates information aimed at reducing the uncertainty, or ambiguity typical of social situations. Unfortunately, the present data do not allow firm conclusions about the kind of information conveyed. In addition, it was rather difficult to address the conflict between people's motivational states that could be at the origin of social tension and displacement activities.

Interestingly, young males displayed significantly more spontaneous smiles than older ones when they were interacting with females. Moreover male talking time was positively related to their frequency of smiling. It is interesting to note that men's speech was interspersed with spontaneous and open smiles to a much larger extent when they were interacting with females than when interacting with other males. The first explanation that comes to mind for such a result is that smiling would be used in men's courtship, and even more so when they are young. This assumption is however difficult to confirm, as the proportion of mixed-sex dyads that were actually engaged in courtship is unknown. Nonetheless even if the situation is not explicitly courtship, there should still be non-verbal signals if members of the opposite sex are attracted to each other (Grammer, 1989). It was evident that when interacting with women, men used spontaneous and open smiles to emphasize utterances, possibly as attempts to

make speech more positive. If smiling is used in conversations to compensate for the description of negative experiences (Lee & Beattie, 1998), the present study suggests that the effect might be more salient when men interact with women.

As opposed to spontaneous smiles, forced smiles were positively related to listening time. It is therefore likely that forced smiles are used in conversations to give feed-back rather than to highlight what is said. Forced smile rate was not associated with listening time when men were observed interacting with women, indicating that female talking had no impact on men's deliberate smiles. Yet, male conversation considerably affected female forced smile rate. This asymmetric pattern could reflect asymmetry in status between sexes, and the fact that men tend to avoid displaying signs of deference and acquiescence in front of women in order to stay away from being perceived as submissive. Furthermore, because female forced smiles had, in turn, little impact on male talking, this type of smile could be considered as relatively passive in conversations between men and women.

In same-sex pairs however, forced smiles appeared to be the main behaviour that kept conversations going. Indeed, the more a person was giving deliberate smiles, the more his/her friend was talking, and vice versa. This indicates that the context and consequences of forced smiles are strongly related to conversations between same-sex people, and hence that this behaviour could function to probe individuals into delivering verbal information. As far as conversation could be a vehicle for biologically relevant information (Dunbar, 1996a) and forced smiles the products of a recently evolved ability to exerce control over facial behaviour (Gazanniga & Smylie, 1990; Sherwood *et al.*, 2004), the present results suggest that smiling could be used in a socially adaptive way. Further research would certainly benefit from investigating the parallels between facial activity and content of conversations.

The sex of people also had an impact on the display of smiling. Men showed higher rates of closed smile than women, and this effect was particularly strong when men were conversing with other men. In addition, men received significantly more spontaneous smiles from other men than from women whereas the latter received equal

amounts of spontaneous smiles from both sexes. This suggests that spontaneous and closed smiles are crucial to male's intra-sexual relationships, and that could be either in the regulation of status related tensions, or in the establishment of male alliances. Yet, the absence of relationship between smiling and tension indicators suggests that smiling could be used for another purpose that the mere settlement of hierarchical squabbles. On the other hand, the idea that the advertisement of cooperative dispositions could be achieved through spontaneous smiling has already received support in other studies (Brown *et al.*, 2003). In any case, cooperative bonding certainly requires the inhibition of aggressive tendencies. As a signal of non-hostile intentions, smiling could be particularly relevant to bonding between males because their relationships are usually characterised by higher levels of hostility resulting from a more overt type of social competition (Daly & Wilson, 1983; Eibl-Eibesfeldt, 1989).

Low intensity laughs were positively linked to talking and listening time in male dyads only, suggesting that conversation might therefore be a main source of laughter in male interactions. However, the fact that laughter was not exclusively linked to either talking or listening gives little support to Provine (1993) who had found that speakers laugh more than listeners. On the other hand, male talking appeared to be considerably affected by females' laughter. The more a woman was laughing the more she elicited speech in their male partner, but only if their laughs were of high intensity. High intensity laughs were mostly vocalised. If women's vocalised laughter communicates interest in men (Grammer & Eibl-Eibesfeldt, 1990), the present study shows that men could respond to it by more talking. These results therefore confirm the particular status of voiced laughter in social relationships (Bachorowski & Owren, 2001). Furthermore, the present data support earlier research reporting that female's non-verbal behaviour could be designed to control the development of interactions with males (Grammer *et al.*, 2000).

Curiously, displacement activities were positively associated with high intensity laughter rate in all-female pairs. Grammer and Eibl-Eibesfeldt (1990) had found that women's interest in joining another woman in friendly activities (e.g. going to the cinema) was negatively related to frequency of voiced laughter displayed by that

woman (whereas the opposite was true for non-vocalised laughs). It is possible that high rates of voiced laughter in females generated some form of anxiety about the way her friend would interpret these laughs and therefore raised the level of displacement behaviours.

The emotional context between friends, as reflected by the presence of body contacts, appeared to be strongly related to women's, but not men's, open smiling and laughter. Indeed women who had at least one body contact with their friend exhibited higher rates of laughter and open smiles than females who showed no contact. Furthermore, among individuals who had body contacts, women showed higher rates of laughter and open smiles than men. In fact, open smiles appeared to positively influence the likelihood of having body contacts in women but not in men. Open smiling and laughter might therefore be more important in female's intimate relationships than in males'. This assumption is further supported by the finding that high intensity laughter in men seemed to decrease the odds of having physical contacts with their friend.

All in all, this chapter showed that the display of smiling and laughter varies from one social situation to the other, and that their frequency of occurrence is strongly related to the incidence of other social behaviours, such as conversation and body contacts. More importantly, the different forms of smiling did not vary in the same way across social contexts and appeared to have different social consequences. These results substantiate earlier research indicating that smiling has different meanings, but also show that people could use smiling and laughter on an every day basis, in a socially adaptive way. The next chapters will examine the function of smiling in more details, first by investigating its effect on social perception, and finally by looking at its connection with personality and emotion in the context of sharing with friends.

Chapter Four

EFFECT OF SMILING ON SOCIAL JUDGEMENTS

The previous two chapters showed that smiling is used repeatedly during interactions between friends, and that its rate of occurrence depend on the social context. In addition, different forms of smiles seemed to be affected by the context in different ways, and could therefore have a different function in social relationships. More importantly, chapter two indicated that spontaneous smiling could be used in the formation and maintenance of friendship, suggesting that smiling conveys information relevant to the development of social relationships. The present chapter investigates what kind of information could be available from smiling. Moreover, the following study examines whether men and women differ as to how smiling is perceived, and if the type of smile influences judgements made on senders.

1. Introduction

An ability to detect dispositions and intentions from behaviour can be extremely advantageous to individuals because it leads to a better knowledge of the social environment and therefore to a better adjustment of behaviour in interpersonal relationships. For example, non-verbal cues could help identifying cheaters (Dunbar, 1993a; Yamagishi, 2003), or valuable mating partners (Moore, 1985; Moore & Butler, 1989; Grammer, 1989; Renninger *et al.*, 2004). Also, some authors argue that social knowledge is organised in mental schemas that consist of personality traits linked to behavioural instances of those traits (Srull & Wyer, 1979, 1980). The activation of these cognitive structures would be achieved through the perception of a trait, or a trait-related behaviour, included in the schemas (Higgins *et al.*, 1977). Consequently, the assessment of facial behaviour and in particular smiling could – through the

activation of mental representations – allow receivers to predict and control the outcome of social interactions.

From the sender's viewpoint, the crucial aspect of smiling could be its efficiency at changing the perceiver's attitude towards him or her. Given that people have automatic perceptual and behavioural responses to social cues (Mischel, 1973; Berkowitz, 1984; Higgins, 1987; Barkow *et al.*, 1992), smiling could work by creating positive impressions in receivers and thereby influence their subsequent behaviours towards the sender. If this is the case, the judgement of a person's traits should change significantly according to whether that person smiles or shows a neutral face. Previous studies showed that smiling faces are generally rated more positively than neutral ones. In particular, smiling faces are rated as being more attractive (Lau, 1982; Reis *et al.*, 1990; Otta *et al.*, 1994, 1996, Beattie & Shovelton, 2002), but also happier, more extrovert, more sympathetic, and kinder (Otta *et al.*, 1994, 1996). There is also a relationship between non-smiling people and judgements of dominance (Keating *et al.*, 1981). Unfortunately most of these studies did not discuss the adaptive significance of the traits that are generally affected by smiling. Although past research told us what information might be available through smiling, it did not mention whether the information conveyed could be used adaptively in the social domain. This chapter's main objective is to investigate the effect of smiling on the perception of evolutionarily relevant attributes.

1.1 Smiling and Attractiveness

Attractiveness is believed to be particularly important in the evolution of social behaviour because it could reflect a valuable reproductive potential (Grammer & Thornhill, 1994). Although this dimension has been mainly studied in the context of mate choice, Thornhill and Gangestad (1993) pointed out that attractiveness could be relevant in all types of social alliances. The perception of attractiveness could therefore be essential to the development of social relationships.

The link between smiling, attractiveness and sexual displays received support in a few behavioural and neurobiological studies. For example, field observations conducted by Monica Moore (1985) showed that smiling was among the most prevalent behaviours observed in a catalogue of female non-verbal courtship displays. In addition, studies investigating smile perception found that smiling faces were perceived as being more attractive than neutral ones (Lau 1982, Reis *et al.* 1990, Otta *et al.* 1994, 1996; Beattie & Shovelton, 2002). Neuroscientists also showed that the activation of a brain region associated with stimulus-reward value (the orbitofrontal cortex) was enhanced by the perception of attractive and smiling faces (O'Doherty *et al.*, 2003). These authors therefore concluded that the rewarding value of attractive faces could be enhanced by the presence of a smile (*ibid.*).

There are a couple of reasons why smiling people could be seen as more attractive. First, smiles could display physical characteristics that are more or less directly related to fitness. For example, the exposure of mouth elements, such as teeth and gum quality, could reveal cues to health, parasite resistance, or a favourable developmental condition. The opening of the mouth should therefore be crucial in the advertisement of mate quality. Second, smiling could reveal personal attributes that are highly valued by opposite-sex partners. In that case, the difference in the judgement of smiling people should follow traditional sex differences in mate preferences. Men should judge smiling women higher on cues related to physical attractiveness, whereas women should give higher ratings to smiling men on attributes associated with wealth, status, and commitment. Furthermore if smiling is important to mate choice, women's ratings of male smiling faces should change positively over more dimensions than men's ratings of female smiling faces, as women generally use more cues than men when evaluating prospective mates (Grammer, 1989).

1.2. Smiling and Cooperation

An increasing amount of research suggests that smiling could act as a signal facilitating the identification of cooperative partners (Scharlemann *et al.*, 2001; Brown & Moore, 2002; Brown *et al.*, 2003), indicating that the propensity to engage in

cooperative relationships could be advertised through smiling. The psychological basis underlying cooperation might nevertheless consist of a variety of specific traits such as generosity, trustworthiness, and low competitiveness. Therefore, the relationship between smiling and cooperation could result from a possible association between smiling and the traits that generally motivate cooperation.

Generosity could reflect an altruistic inclination, as it is usually understood as the tendency to give more of something than is necessary or expected (Pearsall, 2002). Generosity could signal the intent to cooperate, and it has been shown that a reputation obtained through generosity can lead to fitness related benefits (Gurven *et al.*, 2000a). For example among the Ache, a group of South-American horticulturists, those who share and produce more resources than average are usually rewarded with more food from more people in times of injury or sickness, than people who shared and produced less than average (*ibid.*). Moreover, in experiments using direct and indirect reciprocity games, Wedekind & Braithwaite (2002) showed that generosity could result in the formation of a reputation that is later rewarded by third parties. These results support the proposition that generosity and altruism could evolve in social contexts where repetitive encounters between individuals are part of everyday life (Trivers, 1971), situations that are typical of most primate species, including humans (Dunbar, 1988).

If generosity drives people to give more than they actually receive, it is sensible to assume that generous people will be sought after as cooperative partners, because the benefits of associating with such individuals could be potentially larger (Roberts, 1998). It could be argued that the act of giving itself could be sufficient to indicate a willingness to cooperate. Nonetheless, the need for a separate signal advertising generosity might be particularly useful in contexts were indirect reciprocity occurs. In these situations, individuals are provided with benefits by third parties, as a result of their past generosity to anyone (Nowak & Sigmund, 1998; Leimar & Hammerstein, 2001). More importantly, the uncertainty of social contingencies might not give the opportunity to perform generous acts each time that a benefit is claimed. In other words, people might need help at times when it is impossible for them to demonstrate generosity. This implies the necessity for individuals to display and identify the

propensity to be generous, issues that could be addressed by the use of non-verbal cues such as smiling. The relationship between smiling and generosity has not been investigated so far. It could be that smiling advertises the propensity to be generous, an asset displayed and sought after by individuals willing to invest in cooperative relationships. If this is the case, ratings of generosity attributed to smiling faces should be higher than those attributed to neutral ones.

Trustworthiness might also be a relevant aspect of cooperation because the ability to be relied on as honest could be considered essential to respect social contracts (Ostrom & Walker, 2003). More precisely, signalling trust to someone might increase receiver's expectations of reciprocity and therefore the likelihood that he/she will engage in a cooperative relationship. Recent research showed that the higher an image was rated on the trustworthiness scale, the higher the probability that the image generated a trusting move in a bargaining game (Scharlemann *et al.*, 2001; Eckel & Wilson, 2003), indicating that trustworthiness could be a major trait in the development of long-term alliances.

There is evidence that smiling could advertise trustworthiness. For example, social psychologists reported that smiling newscasters may influence political candidate choice (Mullen *et al.*, 1986), a finding that could be explained by the fact that smiling faces are generally perceived as being more reliable and sincere than neutral ones (Otta *et al.*, 1994). Trustworthiness also appeared to be the main mediator of the effect of smiling on the attribution of leniency to transgressors (LaFrance & Hecht, 1995). Moreover, a recent study investigating the role of smiling in bargaining contexts showed that people were more likely to trust photographs of a smiling person than a neutral version of the same person (Scharlemann *et al.*, 2001). Sex differences were found in the attribution of trustworthiness. Although female faces were judged as being more trustworthy regardless of the expression, it was found that trustworthiness scores were positively related to whether the image was smiling or not – indicating that smiles convey trustworthiness (Scharlemann *et al.*, 2001; Eckel & Wilson, 2003). If smiling does inform about the propensity to be trusted as a person, smiling faces should receive higher scores on trustworthiness ratings than neutral ones.

Adopting a competitive attitude is certainly detrimental to the development of a cooperative relationship. Indeed, the control of intra-group competition guarantees that the benefits of a cooperative venture are shared equally between people who contributed to it (Hand, 1986; Vehrencamp, 1983). This implies that hierarchical relationships should be kept to a lower level and that competition should be de-emphasized. Competition is therefore relevant to cooperation, albeit in an opposite way. If the inhibition of competitive tendencies is necessary to establish a cooperative relationship, individuals should find ways to alleviate contests, i.e. to communicate that they will not attempt to challenge each other. Following the evidence that the *silent bared-teeth* display is used to signal non-hostile intentions (Preuschoft & van Hooff, 1997; Waller & Dunbar, 2005), smiling could have evolved to de-emphasize competitive tendencies in groups where cooperation replaced coercive contests as a way to exploit and allocate resources. Consequently smiling faces should be perceived as being significantly less competitive than their neutral counterparts.

1.3. Smiling and Personality

Research conducted over the last decades gave rise to a consensus over five fundamental and orthogonal (i.e. independent of each other) personality traits (McCrae & Costa, 1987; McCrae & Terracciano, 2005). These traits, which were first introduced by Norman (1963) with slightly different labels, are: agreeableness, conscientiousness, extroversion, neuroticism, and openness to experience (McCrae & Costa, 1989). Some authors have also suggested that personality traits would be used by people to evaluate and categorise each other (Borkenau, 1990; Hogan, 1983). Furthermore, there is evidence that these five fundamental dimensions could be common to all human groups and cultures (McCrae & Terracciano, 2005).

From an evolutionary perspective, personality dimensions could be a set of dispositions that lie beneath the adaptive strategies people use to achieve survival and reproductive goals (Buss, 1991). Personality traits could therefore represent the diversity of the social background to which people have to adapt (*ibid.*). Buss (1991) proposed that personality traits provide information to answer adaptive questions such

as whom to mate with or whom to rely on in social alliances. Studies in personality psychology proposed that the evolutionary significance of agreeableness as an adaptive personality dimension might be related to the formation of alliances and cooperative relationships (Graziano & Eisenberg, 1990; Ashton *et al.*, 1998). As a positive personal attribute, agreeableness could foster people's desire to include others in a social group (Buss, 1991). Besides, Eysenck (1976) showed that individual differences in extroversion are linked to differences in sexual access to partners, whereas conscientiousness is known to be correlated to work and status attainment (Kyl-Heku & Buss, 1996). All in all, information about the personality of other group members might be crucial for people's adaptation to the social world.

Yet the problem of how people access other individual's personality remains to be solved. Psychological research provided hints suggesting that non-verbal behaviour could serve as a major channel in the acquisition of such precious information. Indeed, people can be accurate at predicting personality traits after minimal exposure to non-verbal cues (Funder & Colvin, 1988; Albright *et al.*, 1988; Gangestad *et al.*, 1992; Borkenau & Liebler, 1993, 1995; Levesque & Kenny, 1993). Nonetheless only a few studies reported associations between the "Big Five" personality traits and smiling. For example, the frequency of smiling displayed by targets while reading a standard text was significantly correlated with ratings of extroversion, agreeableness, emotional stability (the opposite of neuroticism), and openness to experience (Borkenau & Liebler, 1995). This suggests that people who smile a lot are rated more positively on most personality dimensions (with the exception of conscientiousness). In addition, Otta *et al.* (1994) showed that smiling faces received higher ratings on extroversion. Unfortunately these studies did not show how personality judgements of the same person could differ according to the expression displayed by that person. That aspect is crucial because a change in perception would indicate a possibility for senders to modify their social image to their own advantage. The present study investigates whether a link can be drawn between smiling and the five major personality dimensions.

1.4. Sex Differences in Smiling

Men and women have different approaches to social relationships, and it is likely that different aspects of personality are emphasized when people interact with same-sex than with opposite-sex individuals. Literature reviews on sex differences in smiling reported that women usually smile more than men (Hall, 1984; Hall & Halberstadt, 1986; LaFrance *et al.*, 2003). Furthermore the sex difference seemed to be greater in same-sex than in opposite-sex pairs (LaFrance *et al.*, 2003). In other words, women appeared to smile more when interacting with women than men did when interacting with other men, whereas the sex difference would be weaker in male-female dyads. Another moderator of sex differences in smiling was social tension (Hall & Halberstadt, 1986), and women tended to smile more than men when social tension was high. However, Cashdan (1998) reported that the sex difference observed in high social tension could be a consequence of men smiling less, rather than women smiling more. Sex differences in the display of smiling could therefore reflect differential adjustments made by men and women to particular situations. Similarly, these sex differences could reveal the different emphases placed by men and women on the social characteristics deemed relevant to a certain social context. Therefore, it is likely that the impact of smiling on social judgements will vary according to the type of judgement that is made and to the sex composition of the sender-receiver dyad.

According to evolutionary theory, sex differences in psychology and behaviour result from differences in the strategies used to achieve reproductive success (Geary, 1998; Mealey, 2000). Given the distinct selective pressures to which males and females have been exposed in their evolutionary past, they might not be equally sensitive to smiling. Indeed, there is evidence that women are generally more attuned to non-verbal behaviour than men (Hall, 1984; Argyle, 1988). Although this could result in a larger effect of smiling on female's than on male's social judgements; a higher sensitivity to non-verbal behaviour could have evolved in women as an ability to perform more careful social judgments. This would result from the fact that costs associated with risky social choices are usually larger for women than for men, whether these choices are made in the selection of mates (Grammer, 1989), or in friendship (Campbell,

2002). Because a single cue might not be sufficient to alter the judgement of highly selective individuals, ratings made by female judges should be expected to be influenced by smiling in a lesser extent than those made by male judges.

1.5. Smile Type and Trait Perception

No matter which trait smiling is meant to express, the mere suggestion that it does express something beneficial to the sender makes the possibility of social manipulation an appealing option for nature to select for. With a better control over their face, individuals could adjust their smiles to specific situations as they navigate in the social environment, and could therefore claim positive characteristics whenever potential benefits are perceived or expected. For that reason, a specialisation aimed at controlling facial displays could be particularly helpful in complex social environments. Interestingly, recent research showed that in comparison to Old World monkeys, great apes and humans have developed neurological structures that would allow an increased control over facial musculature (Sherwood *et al.*, 2004, 2005). These findings have been interpreted as evidence for adaptations to increased social complexity (Parr *et al.*, 2005). Therefore, if conscious processes evolved to make behavioural adjustments that are finely tuned to the environment, a better control of smiles could help individuals adapt to the social world.

It was discussed earlier in chapter one that manipulative signalling and possible exploitation by free-riders represented a strong pressure on receivers to evolve resistance to deceptive signals (Dawkins & Krebs, 1978). In our case, the degree of control individuals have gained on facial behaviour and the effect of smiling on trait perception set forward the obvious problem that people could smile and successfully claim specific traits whenever the relevant situation presents itself. Individuals who were particularly sensitive to the impact of smiling might have become more vulnerable to social exploitation by socially skilled individuals, which, in turn constituted a selection pressure for the evolution of a counter strategy based on a higher discrimination of smiles.

Dawkins and Krebs (1978) underlined the fact that signalling is not always deceptive but can also be adaptive for both parties involved. In that context, the evolution of reliable signals appeared like a way out of the evolutionary arms race between sender and receiver. The ability to discriminate between reliable and deceptive signals therefore became crucial for the adaptation to the social environment, as it could help individuals avoid exploitation by free-riders. These considerations could apply to many social behaviours, including smiling, which has been shown to take a variety of forms (Ekman & Friesen, 1982). Therefore, the presence of different types of smiles in human's behavioural repertoire could result from selective pressures imposed by receiver psychology and the need to develop reliable signalling. It is important to note that the ability to distinguish between different types of smile do not require conscious awareness in order to be functional (Schmidt & Cohn, 2001). This ability could therefore be reflected in a different treatment of faces that show different types of smiles.

Cooperation between unrelated individuals is a social sphere in which exploitation by free-riders could be particularly detrimental. Indeed, a failure from the partner to retaliate a favour could quickly eliminate the benefits expected from a cooperative relationship. Robert Trivers (1971) suggested that the possibility to identify individuals likely to reciprocate in the future would be an important solution to the issue of commitment between unrelated individuals. In that respect, prospective altruist-detection would be particularly adaptive because it would help avoid interactions with cheaters before exploitation could occur (Brown & Moore, 2000). As a support to that claim, computer simulations showed that a partner preference is ecologically reasonable and allows for the evolution of cooperation (Cooper & Wallace, 1998).

Past research also suggest that smiling could act as a signal that facilitates the identification of cooperative partners (Scharlemann *et al.*, 2001; Brown & Moore, 2002; Brown *et al.*, 2003). This follows an earlier emphasis by some authors on the role of pro-social emotions in the resolution of commitment problems (Trivers, 1971; Hirshleifer, 1987; Frank, 1988). According to these models, non-verbal cues that are related to positive emotions are seen as honest signals of altruistic dispositions

because, as a result of their contingency with physiological processes, they are not easy to fake (Hirshleifer, 1987; Zahavi, 1987; Frank, 1988; Grafen, 1990; Zahavi & Zahavi, 1997). The findings that some forms of smiles, but not others, are consistently associated with positive emotions (Ekman *et al.*, 1988, 1990; Surakka & Hietanen, 1997) suggest that smiling is a good candidate for the advertisement of altruistic intentions and dispositions.

According to Ekman and Friesen (1982), the Duchenne smile would be a genuine sign of positive emotion whereas other forms of smiling would constitute voluntary attempts to follow cultural display rules, i.e. expressing positive feelings when it is socially prescribed to do so. The main difference between Duchenne and non-Duchenne smiles can be described in terms of which facial movements are present on the face at a particular time. The co-occurrence of lip corner raise and cheek raise characterises Duchenne smiles, whereas the sole action of lip corner raise represents non-Duchenne smiles. The cheek raise is produced by the activation of *orbicularis occuli* a muscle that is believed to be under involuntary control (Ekman *et al.*, 2002). Consequently, spontaneous smiles associated with positive emotions would have a particular signal value because they are not easy to produce on purpose. Past research strongly suggest that Duchenne smiles could be reliable cues to altruism (Brown *et al.*, 2003). The presence of a Duchenne smile should therefore produce different effects on the judgements of traits related to cooperation, such as trustworthiness, generosity, and competitiveness.

2. Method

2.1. Material

Fifty individuals (25 males, 25 females) were photographed and their pictures were used as stimuli in a face perception experiment. Faces were from a Caucasian sample and were selected on the basis that they had no extreme distinctive features such as

jewellery, dyed hair, or severe skin or teeth condition. Two pictures were taken for each individual: a picture showing a neutral face and a picture showing a smiling face. Both sets of faces were then rated by independent judges on separate Likert scales ('1': not at all, '4': neutral, '7': very much) for ten different attributes: attractiveness, generosity, trustworthiness, competitiveness, health, agreeableness, conscientiousness, extroversion, neuroticism, and openness to experience. These attributes were presented to participants in a random order, and the 50 stimuli-faces within each category were also arranged in a random order.

In addition to the ratings made by participants, each of the smiling face was coded using the most recent version of the Facial Action Coding System (Ekman *et al.*, 2002), by a certified coder. Four facial action units were included in the study: cheek raiser 'AU 6', lid tightener 'AU 7', lip corner puller 'AU 12', and lip parting 'AU 25'. Intensity was recorded using the numbers 1 to 5, respectively for the five categories of intensity described in FACS. Smiles were then classified into Duchenne and non-Duchenne with respect to the criterion used by Ekman and Friesen (1982), i.e. the co-occurrence of 'AU 6' and 'AU 12' indicated the presence of the Duchenne type.

2.2. Participants

The panel of judges consisted of 58 people (29 males, 29 females) ranging in age from 19 to 35 year old ($M = 27.8$, $SD = 3.6$) and belonging to the same ethnic group than the faces they had to evaluate. None of the participant involved had any contact with the people depicted on the pictures. Participants were asked to rate the 50 stimulus pictures on the ten dimensions mentioned above. Each judge was randomly assigned to either the control or the experimental condition, respectively neutral or smiling, and each condition included an equal representation of men and women.

2.3. Data Analysis

The overall effect of smiling on the perception of individual attributes was investigated using a 2 × 2 × 2 mixed repeated measure MANOVA, with sex of face as a within-

subject factor, and experimental condition (neutral vs. smiling) and sex of judges as between-subject factors. In addition, Student *t*-tests were conducted to assess the impact of smiling in each type of sender-receiver dyad: male-male, male-female, female-male, female-female. Student *t*-tests were also conducted to investigate the interaction effects revealed by the analyses of variance. Effect sizes (*d*, Cohen, 1969) were computed using 'Effect Size Generator 2.3' (Devilly, 2004).

A score representing the change in perception was also computed for each stimulus face by subtracting the score given to the neutral version from the score given to the smiling version of the face. The score difference between the two conditions, as an indicator of the effect of smiling, was used in a Student *t*-test as the dependent variable when investigating sex differences, i.e. to assess whether the impact of smiling differed between male and female raters. The same dependent variable was used to analyse the effect of Duchenne smile on the ratings of personal attributes in a 2 × 2 × 2 repeated measure design, with sex of faces and type of smile as between-subject factors, and sex of judges as a within-subject factor.

3. Results

3.1. Effect of Smiling on Social Judgements

Multivariate tests showed that ratings were significantly affected by the experimental condition, $F(10, 45) = 3.31$, $p = .003$, and by the sex of faces, $F(10, 45) = 18.23$, $p < .001$. These effects show that, on the whole, smiling faces were judged more positively than neutral ones, and female faces received higher ratings than male faces. There was no effect of sex of judges, $F(10, 45) = 0.93$, $p = .51$, indicating that overall, men and women did not differ in the scores they allocated to faces.

Univariate tests revealed that the ratings of several (but not all) dimensions were affected by the experimental condition. As shown in *Table 4.1*, smiling faces received significantly higher scores than neutral faces on attractiveness, generosity, health,

agreeableness, extroversion, and openness to experience. Overall, the ratings of other dimensions were not significantly affected by smiling, although the effect of smiling on the ratings of these dimensions were associated with moderate effect sizes.

Table 4.1: Means and standard deviations for the ratings of neutral and smiling faces by all judges. $^{*}p < .05$, $^{**}p < .01$

Attributes	*Neutral, n=31*	*Smiling, n=27*	*F (1, 54)*	*d*
Attractiveness	3.13 (0.75)	3.63 (0.56)	7.49**	.75
Generosity	4.02 (0.57)	4.42 (0.46)	8.18**	.77
Trustworthiness	4.10 (0.47)	4.25 (0.51)	1.34	.31
Competitiveness	4.05 (0.47)	4.26 (0.43)	2.97	.47
Health	4.34 (0.52)	4.76 (0.55)	9.04**	.78
Agreeableness	3.97 (0.48)	4.38 (0.46)	11.62**	.87
Conscientiousness	4.38 (0.38)	4.53 (0.42)	1.96	.37
Extroversion	3.84 (0.48)	4.34 (0.35)	19.53**	1.19
Neuroticism	3.99 (0.64)	3.77 (0.45)	2.36	.40
Openness	4.04 (0.42)	4.29 (0.41)	4.88*	.60

3.2. Sex Differences in the Effect of Smiling on Social Judgements

There was a significant interaction effect between 'sex of face' and 'experimental condition' (neutral vs. smiling) on the ratings of attractiveness, $F(1, 54) = 5.45$, $p = .02$, and trustworthiness, $F(1, 54) = 4.74$, $p = .03$. A Student *t*-test showed that the impact of smiling on the judgements of attractiveness and trustworthiness was significant for female but not for male faces. Besides, female faces were rated as being significantly more attractive and trustworthier than male faces in both conditions, but the sex difference was much larger in the smiling condition (*Table 4.2*). These results are illustrated in *Figures 4.1* and *4.2*.

Table 4.2. Average scores (and standard deviations) of attractiveness and trustworthiness given to male (n = 25) and female (n = 25) faces in the neutral and smiling conditions. $^{*}p<.05$, $^{**}p<.001$, $^{(1)}$ Effect of experimental condition, $^{(2)}$ Effect of sex of faces.

Attributes	*Faces*	*Neutral, n=31*	*Smiling, n=27*	$t^{(1)}$	$d^{(1)}$
Attractiveness	male	3.04 (0.84)	3.37 (0.69)	1.66	0.44
	female	3.23 (0.71)	3.88 (0.61)	3.70^{**}	0.98
	$t^{(2)}$	2.62^{*}	4.09^{**}		
	$d^{(2)}$	0.25	0.78		
Trustworthiness	male	3.90 (0.54)	3.93 (0.58)	0.20	0.05
	female	4.30 (0.49)	4.57 (0.51)	2.08^{*}	0.55
	$t^{(2)}$	5.22^{**}	7.84^{**}		
	$d^{(2)}$	0.77	1.18		

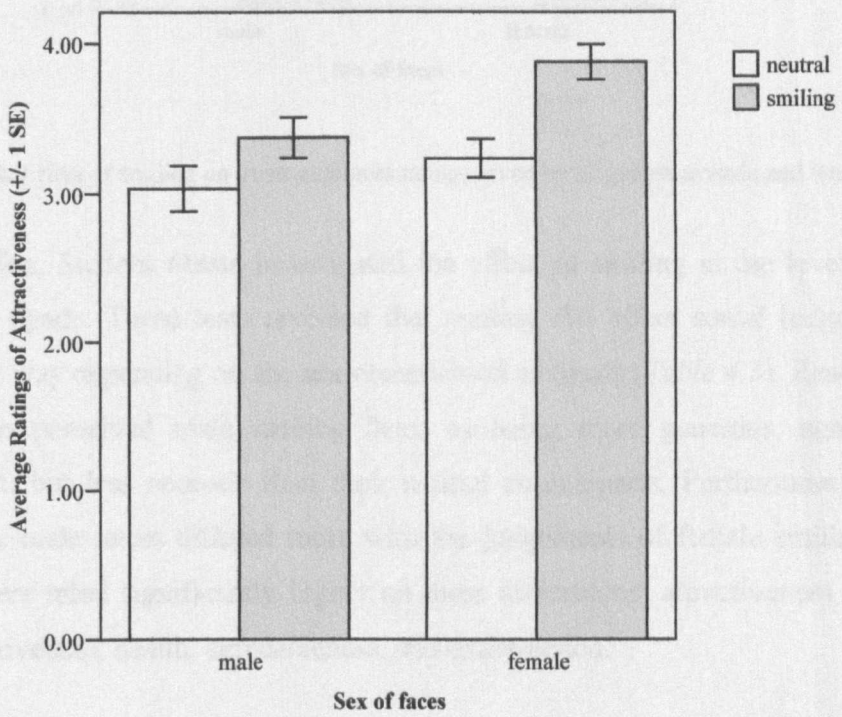


Figure 4.1. Effect of smiling on attractiveness ratings given by all judges to male and female *faces*.

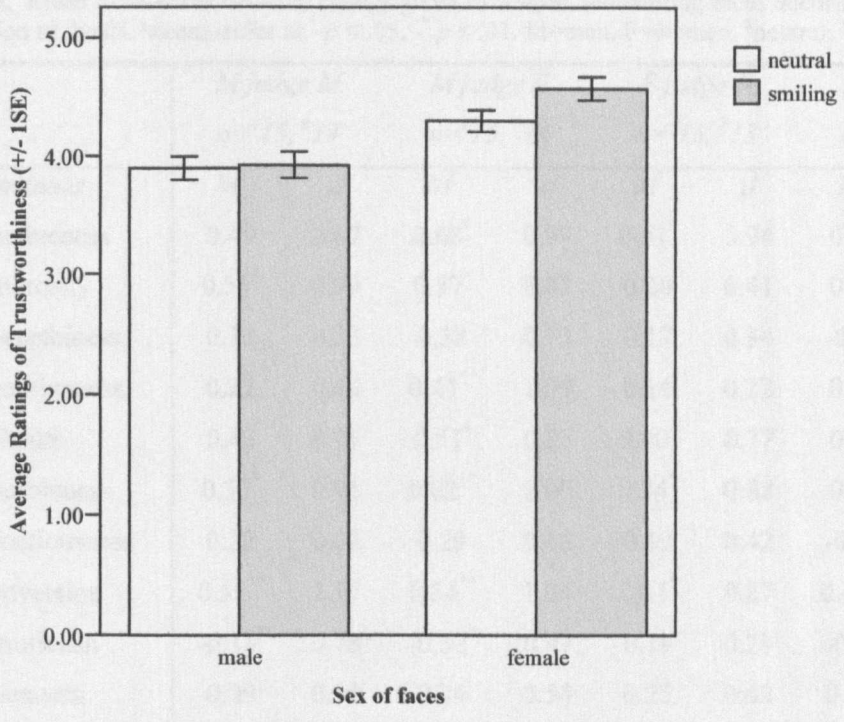


Figure 4.2. Effect of smiling on trustworthiness ratings given by all judges to male and female *faces*.

In addition, Student *t*-tests investigated the effect of smiling at the level of sender-receiver dyads. These tests revealed that smiling did affect social judgements in a different way depending on the sex composition of dyads (*Table 4.3*). Results indicate that men perceived male smiling faces as being more generous, agreeable, and extrovert, but less neurotic than their neutral counterparts. Furthermore, the scores given by male raters differed more with the judgements of female smiling faces, as these were rated significantly higher on most dimensions: attractiveness, generosity, competitiveness, health, agreeableness, and extroversion.

On the other hand, male's smiling faces influenced female judges in a much lesser extent, as only two dimensions were affected by smiling. Male smiling faces were perceived by women as being significantly more extrovert and more open to experience than their neutral equivalents. Women's ratings were influenced differently when viewing female faces. Attractiveness, health, agreeableness, and extroversion scores changed significantly between conditions, with smiling faces receiving higher scores than neutral ones (*Table 4.3*).

Table 4.3. [1]Mean differences between ratings given to neutral and smiling faces according to the sex composition of dyads. Means differ at $^{*}p < .05$, $^{**}p < .01$. M=men, F=women. [a]neutral, [b]smiling

	M judge M $n=^{a}15, ^{b}14$		*M judge F* $n=^{a}15, ^{b}14$		*F judge F* $n=^{a}16, ^{b}13$		*F judge M* $n=^{a}16, ^{b}13$	
Attributes	M^{1}	*d*	M^{1}	*d*	M^{1}	*d*	M^{1}	*d*
Attractiveness	0.49	0.67	0.68*	0.99	0.61*	0.94	0.16	0.20
Generosity	0.55*	0.99	0.57*	0.87	0.20	0.41	0.25	0.54
Trustworthiness	0.12	0.23	0.38	0.73	0.17	0.34	-0.07	0.11
Competitiveness	0.22	0.44	0.41**	1.09	0.14	0.22	0.06	0.11
Health	0.43	0.71	0.51*	0.87	0.40*	0.77	0.39	0.66
Agreeableness	0.50*	0.91	0.62**	1.09	0.34*	0.82	0.21	0.49
Conscientiousness	0.22	0.42	0.29	0.66	0.19	0.42	-0.11	0.23
Extroversion	0.55**	1.17	0.54**	1.04	0.44*	0.87	0.48**	1.16
Neuroticism	-0.38*	0.78	-0.52*	0.97	0.19	0.29	-0.18	0.28
Openness	0.09	0.15	0.24	0.54	0.25	0.48	0.41*	1

Men and women differed in the way their perception was affected by the experimental condition. In addition to the analysis at the level of dyads, a Student *t*-test showed that the average difference between neutral and smiling was significantly larger for male than for female judges for the ratings of several dimensions: attractiveness, generosity, competitiveness, agreeableness, conscientiousness, and neuroticism (*Table 4.4*). These results suggest that smiling had a greater impact on men's than on women's judgements of some (but not all) attributes.

Table 4.4. Sex difference in the impact of smiling. Average differences (and standard deviations) between ratings of neutral and smiling faces by male and female judges. These differences were calculated by subtracting scores obtained for neutral faces from scores obtained for smiling faces. $^{(*)}p<.06$, $^{*}p<.05$, $^{**}p<.01$

Attributes	*Men, n=29*	*Women, n=29*	*t*	*d*
Attractiveness	0.59 (0.52)	0.39 (0.60)	2.50*	0.35
Generosity	0.56 (0.60)	0.23 (0.75)	3.75**	0.49
Trustworthiness	0.25 (0.60)	0.05 (0.63)	1.95(*)	0.32
Competitiveness	0.32 (0.48)	0.10 (0.58)	2.05*	0.40
Health	0.47 (0.54)	0.38 (0.41)	1.07	0.18
Agreeableness	0.56 (0.71)	0.27 (0.73)	3.36**	0.40
Conscientiousness	0.25 (0.57)	0.04 (0.56)	2.33*	0.37
Extroversion	0.55 (0.76)	0.46 (0.99)	1.18	0.09
Neuroticism	-0.45 (0.65)	0.01 (0.81)	-3.77**	0.60
Openness	0.16 (0.55)	0.33 (0.71)	-1.63	0.26

The mixed analysis of variance presented earlier in this section showed that *female faces*, but not male's, were judged as being more attractive when smiling (*Figure 4.1*). Interestingly, the same analysis also yielded a significant interaction effect between sex of faces and sex of judges on the ratings of attractiveness, $F(1, 54) = 4.96$, $p = .03$, indicating that the effect of the sex of faces depended on the sex of judges. Results showed that it was women, but not men, who found female faces more attractive than male ones when smiling. *Figure 4.3* illustrates that attractiveness scores given by female judges were influenced by smiling in a larger extent when faces were female ($M = 0.61$, $SD = 0.59$) than when faces were male ($M = 0.16$, $SD = 0.53$), $t = 2.8$, $p = .007$, $d = 0.79$. That effect was less pronouced in male raters, although there was a slight trend ($d = 0.37$). Consequently, women smiling had a larger impact on attractiveness than men smiling when the judgements were made by female, but not necessary male individuals. This effect was not found for the ratings of other traits.

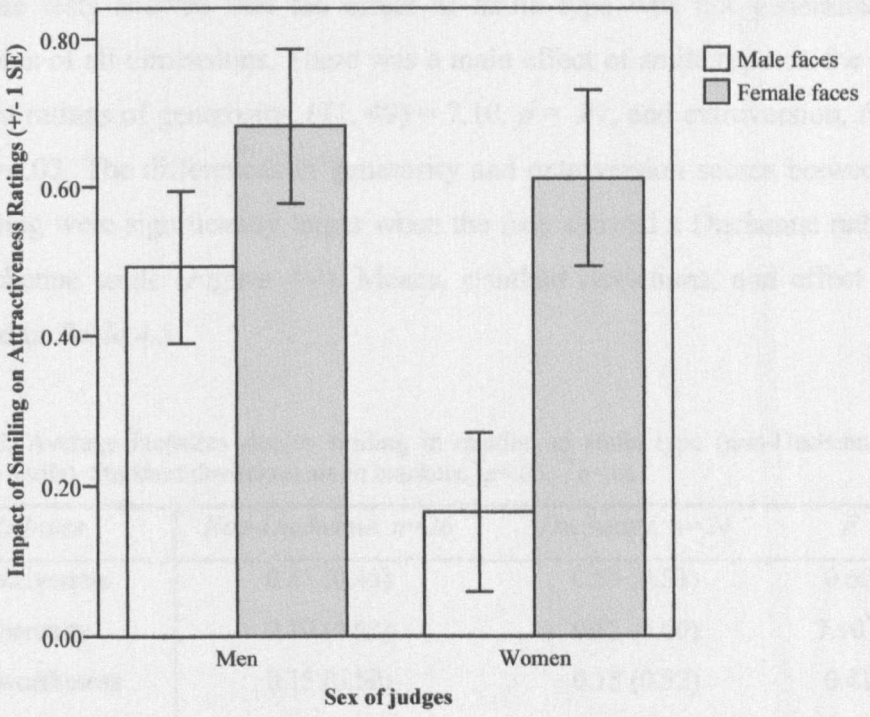


Figure 4.3. Mean difference between neutral and smiling for the ratings of attractiveness given by men and women, to male and female faces

3.3. Effect of Smile Type on Social Judgements

The effect of smile type on social judgements was investigated using a 2 × 2 × 2 repeated measure univariate ANOVA with 'sex of faces' and 'smile type' as between-subject factors, and 'sex of judges' as within-subject factor. The dependent variable was the impact of smiling on social judgements, i.e. the difference between ratings of neutral and smiling faces. Overall, the model showed that the impact of smiling on social judgements was affected by 'smile type', $F(10, 37) = 4.05$, $p = .001$, and by 'sex of judges' $F(10, 37) = 6.29$, $p < .001$. As mentioned earlier in this section, the impact of smiling on the judgements of attractiveness, generosity, competitiveness, agreeableness, conscientiousness, and neuroticism was greater for male than for female raters (*Table 4.4*). Overall, the sex of faces did not affect the change between ratings of neutral and smiling faces, $F(10, 37) = 1.31$, $p = .26$.

Univariate tests showed that the effect of smile type was not generalised to the judgements of all dimensions. There was a main effect of smile type on the degree of change in ratings of generosity, $F(1, 49) = 7.10$, $p = .01$, and extroversion, $F(1, 49) = 5.17$, $p = .03$. The differences in generosity and extroversion scores between neutral and smiling were significantly larger when the face showed a Duchenne rather than a non-Duchenne smile (*Figure 4.4*). Means, standard deviations, and effect sizes are presented in *Table 4.5*.

Table 4.5. Average increases due to smiling in relation to smile type (non-Duchenne smile vs Duchenne smile). Standard deviations are in brackets. $^{*}p<.05$, $^{**}p<.01$

Attributes	*Non-Duchenne, n=26*	*Duchenne, n=24*	*F*	*d*
Attractiveness	0.45 (0.43)	0.53 (0.53)	0.60	0.16
Generosity	0.19 (0.53)	0.62 (0.60)	7.10**	0.75
Trustworthiness	0.15 (0.50)	0.15 (0.52)	0.41	0.01
Competitiveness	0.26 (0.39)	0.16 (0.39)	0.63	0.27
Health	0.43 (0.38)	0.42 (0.40)	0.01	0.03
Agreeableness	0.31 (0.65)	0.52 (0.66)	1.36	0.31
Conscientiousness	0.26 (0.48)	0.03 (0.43)	2.62	0.49
Extroversion	0.25 (0.77)	0.78 (0.86)	5.17*	0.65
Neuroticism	-0.14 (0.60)	-0.29 (0.61)	0.64	0.24
Openness	0.14 (0.58)	0.35 (0.42)	2.09	0.42

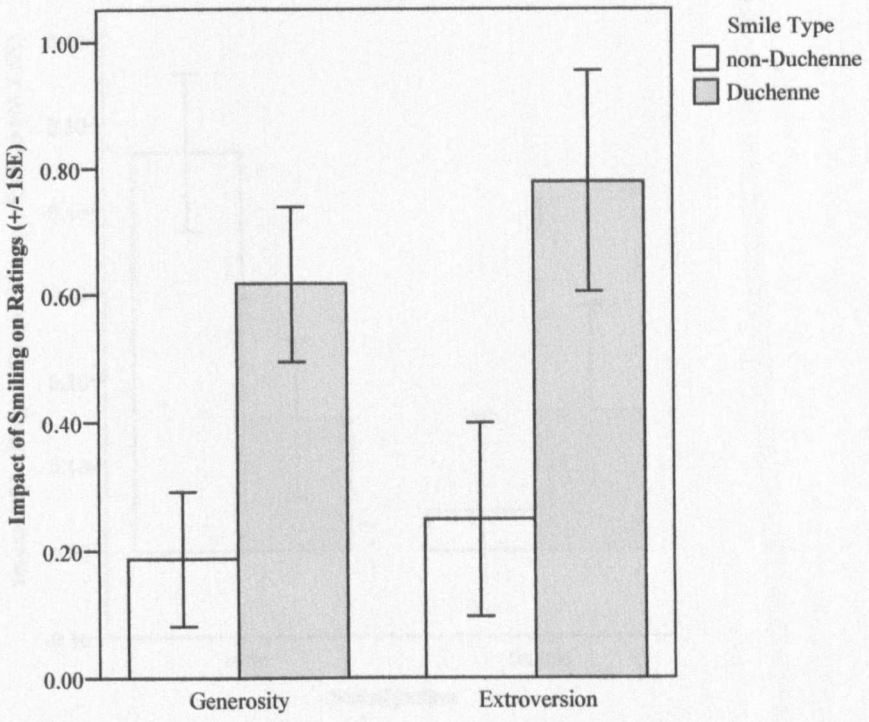


Figure 4.4. Average differences between neutral and smiling for generosity and extroversion ratings in relation to the type of smile displayed by the stimulus face.

The analysis of variance also yielded several interaction effects. There was a significant interaction between 'sex of judges' and 'smile type' on competitiveness ratings, $F(1, 49) = 4.22$, $p < .05$, indicating that the effect of smiling on competitiveness ratings was restricted to male raters and depended on the type of smile. The difference between neutral and smiling for competitiveness scores given by male raters was significantly larger for faces showing non-Duchenne ($M = 0.47$, $SD = 0.47$) than Duchenne smiles ($M = 0.15$, $SD = 0.45$), $t = 2.39$, $p = .02$, $d = 0.68$ (see *Figure 4.5*). The difference between neutral and smiling for competitiveness scores given by female judges was not affected by the type of smile, $t = 0.15$, $p = .88$. For faces showing non-Duchenne smiles, the change in competitiveness ratings was significantly greater in male judges ($M = 0.47$, $SD = 0.47$) than in female judges ($M = 0.04$, $SD = 0.57$), $t = 3.06$, $p = .005$, $d = 0.80$. There was no sex difference for the change in competitiveness scores associated with Duchenne smiles.

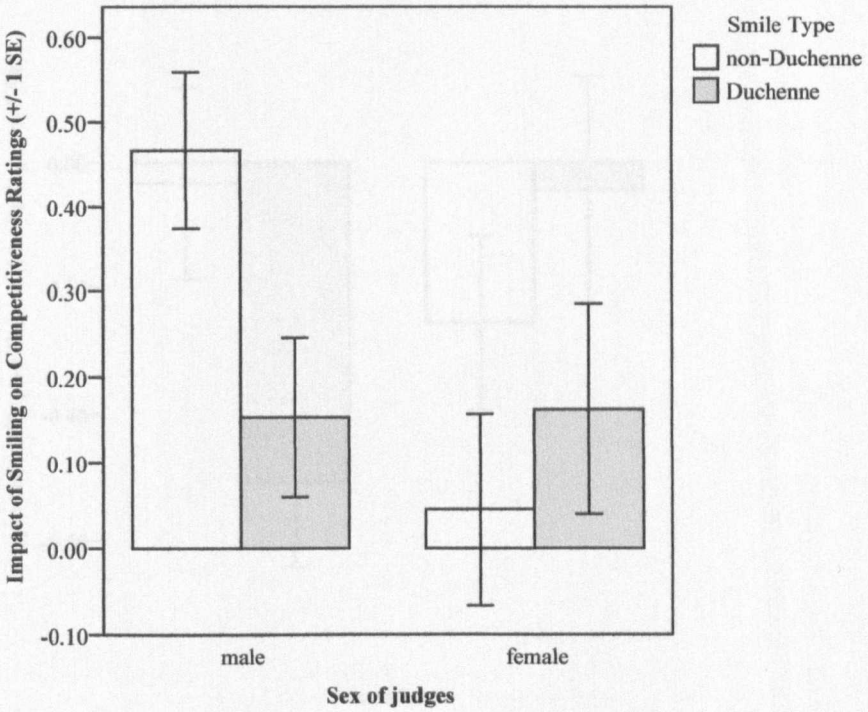


Figure 4.5. Effect of smile type on the difference between neutral and smiling for competitiveness scores given by male and female *judges*.

There was also an interaction effect between 'smile type' and 'sex of faces' on the change in neuroticism ratings, $F(1, 49) = 4.26$, $p = .04$. The impact of smiling on neuroticism scores given to male faces was significantly larger when these faces displayed a Duchenne ($M = -0.51$, $SD = 0.44$, $n = 13$) rather than a non-Duchenne smile ($M = -0.03$, $SD = 0.66$, $n = 12$), $t = 2.15$, $p = .04$, $d = -0.85$. This effect was absent in female faces, $t = 0.59$, $p = .56$. Besides, when the analysis only examined faces with Duchenne smiles, the scores attributed to male faces ($M = -0.51$, $SD = 0.44$, $n = 12$) changed significantly more than those attributed to female faces ($M = -0.04$, $SD = 0.70$, $n = 14$), $t = 2$, $p = .05$, $d = 0.80$. For faces showing non-Duchenne smiles, the effect seemed to be in the opposite direction, with female faces producing a larger decrease in neuroticism ratings than male faces ($d = -0.30$) (*Figure 4.6*). This effect was, however, non-significant, $t = -1.07$, $p > 0.1$.

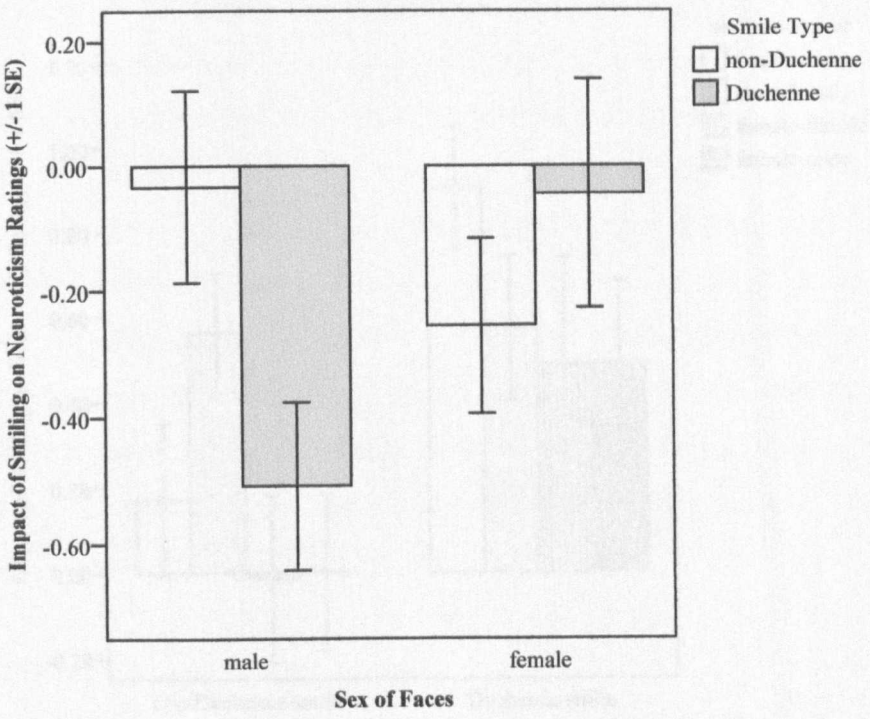


Figure 4.6. Effect of smile type on the difference between neutral and smiling for neuroticism ratings given to male and female *faces*.

Finally, there was a three-way interaction effect between 'smile type', 'sex of judge', and 'sex of face', on the difference between neutral and smiling for generosity scores $F(1, 49) = 4.53, p = .04$. It was reported earlier that the impact of smiling on generosity scores was greater for male than for female *judges* (*Table 4.4*)[4]. Moreover, the type of smile had an effect on the impact of smiling on ratings of generosity (*Figure 4.4*). The three-way interaction showed that the effect of smile type on generosity scores could depend on the sex of the face and judge. As shown in *Figure 4.7*, male *faces* were rated by men as being significantly more generous when showing a Duchenne smile ($M = 0.91$, $SD = 0.53$, $n = 13$) than when showing a non-Duchenne smile ($M = 0.17$, $SD = 0.62$, $n = 12$), $t = 3.19, p = .004, d = 1.27$. Ratings of generosity given by female *judges* to male smiling faces were marginally affected by smile type, $t = 1.84, p = .08$, $d = 0.74$. The effect of smile type on generosity ratings seemed to be restriced to male *faces* and was non-significant for female *faces*, $t = 1, p = .33$.

[4] This effect being independent of smile type and sex of face.

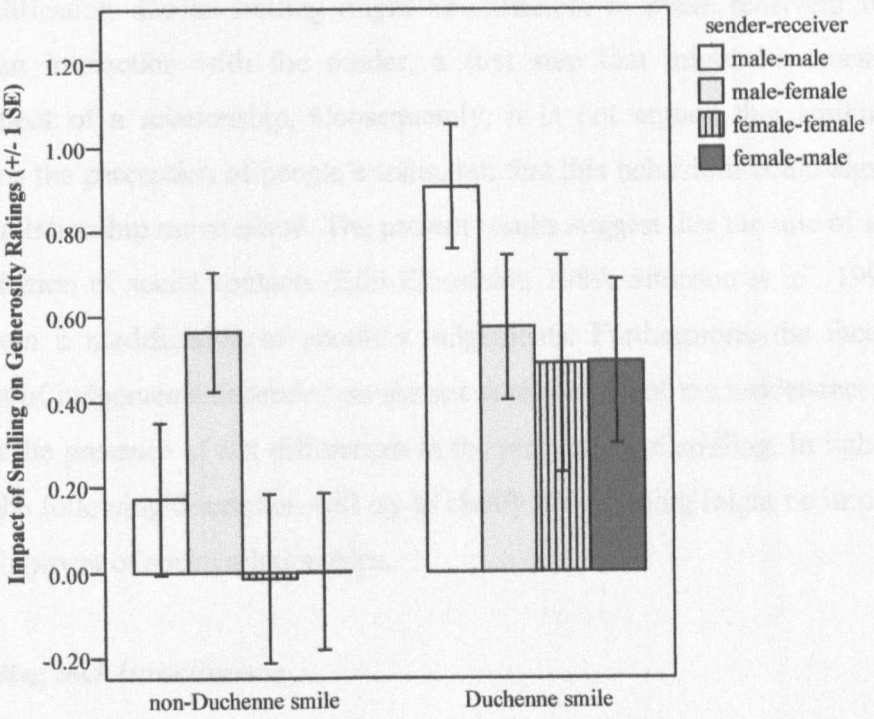


Figure 4.7. Impact of the type of smile on the difference between neutral and smiling for generosity scores in relation to the sex composition of the sender-receiver dyad.

4. Discussion

This study shows that smiling has a significant impact on the judgements of people's traits. Overall, smiling faces were perceived as being more attractive, more generous, healthier, more agreeable, more extrovert, and more open to experience. Although these scores changed significantly between conditions, the overall increase was in the range between 6% (openness to experience) and 16% (attractiveness), with an average of 11% increase. The magnitudes of the effects were moderate to strong, depending on the dimension considered. Note that the dimensions that were not significantly affected by smiling (trustworthiness, competitiveness, conscientiousness, and neuroticism) were nevertheless associated with low to moderate effect sizes, indicating that non-significance could have resulted from low statistical power.

The modification due to smiling might be sufficient to make receivers willing to engage an interaction with the sender, a first step that might be crucial in the development of a relationship. Consequently, it is not argued that smiling totally transforms the perception of people's traits, but that this behaviour could significantly help the relationship move ahead. The present results suggest that the role of smiling in the facilitation of social contacts (Eibl-Eibesfeldt, 1989; Simpson *et al.*, 1993) could result from a modification of people's judgements. Furthermore, the fact that the alteration of judgements depended on the sex composition of the sender-receiver dyad confirms the presence of sex differences in the perception of smiling. In light of these results, the following discussion will try to clarify why smiling might be important for the development of social relationships.

4.1. Smiling and Attractiveness

Despite the fact that on average, these male and female faces were considered relatively non-attractive in both conditions, smiling did clearly influence attractiveness scores for female, but not necessarily male faces. This replicates to some extent previous studies that also found a positive relationship between smiling and attractiveness (Lau, 1982; Reis *et al.*, 1990; Otta *et al.*, 1994, 1996; Beattie & Shovelton, 2002). However, with the exception of Lau's (1982), these studies found that both men and women were considered more attractive when smiling. Note that the effect size for the impact of smiling on male attractiveness was moderate (0.44), suggesting that a possible effect might have remained undetected due to low statistical power. The present data show that smiling might be more relevant to female than to male attractiveness, indicating that this behaviour could be used in a positive way to emphasize a characteristic that is particularly relevant to women.

If smiling was involved in mate choice, it should mostly affect attractiveness ratings given to opposite-sex faces. Although smiling influenced attractiveness judgements of opposite-sex faces (in male but not female judges), the increase in attractiveness depended on the sex of the face rather than on the sex composition of the dyad. Yet one could still argue that smiling could signal mate attractiveness in women only. In

that case, there should be a significant three-way interaction effect between sex of face, sex of judge and experimental condition, showing that the increase in attractiveness judgements given by men is higher for female smiling faces than for male ones. The analysis of variance failed to show such an effect. On the other hand, the significant interaction between sex of judges and sex of faces revealed that it was women more than men who found female smiling faces more attractive than male ones. Thus, the absence of a clear link between smiling and enhanced attractiveness in opposite-sex individuals does not support the assumption that smiling signals mate quality.

Alternatively, the connection between smiling and attractiveness could be interpreted in the context of social attraction. In fact, Moore and Butler (1989) noted that for women, signalling interest in an interaction was more important than physical attractiveness in eliciting approaches from men. Because smiling often expresses a positive engagement in social interaction (Bowlby, 1969; Eibl-Eibesfeldt, 1989; Simpson *et al.*, 1993), that signal could make women more attractive to others. The concept of *social attention holding power (SAHP)* (Gilbert, 1989) could be relevant in this context because it implies that people advertise qualities that are attractive to others and thereby facilitate the formation of partnerships and alliances. In that respect, smiling could be a sign of *SAHP* and could be considered attractive because it advertises positive engagement, a trait that is favoured in social relationships.

4.2. Smiling and Cooperation

It was hypothesised that if smiling plays a role in cooperation, it would influence the perception of traits that lie behind the formation of cooperative relationships. For that purpose, three attributes were retained on the basis of their connection to cooperation. These attributes were generosity, trustworthiness, and competitiveness. The latter was included because of its negative relationship with cooperation.

Data showed that smiling positively influenced generosity ratings irrespective of the sex of the face under assessment. Interestingly, ratings given by men were strongly affected by smiling in comparison to women's (effect sizes for female judges were

only moderate, see *Table 4.3*), indicating that the effect of smiling on generosity could be more pronounced in men than in women. Men's judgements of generosity in neutral faces were negative on average, whereas they became significantly more positive when faces were smiling. On the other hand, generosity ratings given by women were positive in both conditions. The fact that men appeared more reluctant to give high generosity scores to neutral faces indicates that they might require additional information to positively adjust their judgements. This study showed that smiling could convey the necessary information and it is therefore proposed that this behaviour could have a substantial role in the evaluation of potential cooperative partners by men. Brown and colleagues (2003) already showed that smiling could be involved in the detection of altruism. Here, it is shown that men could be particularly sensitive to it. If smiling can affect generosity ratings, it is reasonable to assume that it could be used in the communication of generous dispositions and thereby convey a reputation of generosity, which has been shown to lead to fitness benefits (Gurven *et al.*, 2000a; Wedekind & Braithwaite, 2002).

The impact of smiling on generosity ratings was not only affected by the sex of the perceiver but was also influenced by the type of smile. Interestingly, the effect of smile type interacted with the sex composition of the sender-receiver dyad. Duchenne smiles produced a much greater impact on generosity ratings than non-Duchenne smiles, confirming that the Duchenne marker could be crucial for the advertisement of altruism (Brown *et al.*, 2003). Furthermore, the effect of smile type appeared to be specific to male faces and it was particularly strong in male dyads. The interaction between smile type, sex of face, and sex of judge on generosity ratings suggests three interesting conclusions. First, men could be particularly vulnerable to sensory exploitation by women in the context of generosity advertisment. Indeed, men gave significantly higher scores of generosity to female smiling faces, regardless of the type of smile. On the other hand men became surprisingly more selective when they judged generosity in other men. The second conclusion is that males, more than females, could benefit (in terms of social judgement) from displaying Duchenne smiles when advertising generous dispositions. Given that the Duchenne marker is a facial movement that is difficult to produce on purpose (Ekman *et al.*, 2002), the present

results suggest that men could have been subject to higher selective pressures from receivers in the evolution of altruism based relationships. Finally, women's judgements of generosity seem to be more resistant to non-Duchenne smiles than men's, only when these judgements are made on female faces. All in all, it is likely that the Duchenne smile plays an important role in the advertisement of generosity within same-sex dyads.

As opposed to generosity ratings, the overall effect of smiling on trustworthiness was rather small. In none of the dyads considered did trustworthiness scores change between the experimental conditions. On the whole, smiling failed to increase perceived trustworthiness and this supports earlier findings that trustworthiness judgements might also rely on cues other than smiling (Scharlemann *et al.*, 2001). Nonetheless, women were generally rated more positively than men on trustworthiness, and that difference was more pronounced for smiling faces. This supports studies that reported sex differences in the perception of trustworthiness (Scharlemann *et al.*, 2001; Eckel & Wilson, 2003) and shows that to some extent trustworthiness is not completely independent from smiling. It seems that smiling did – at least for females – improve apparent trustworthiness, suggesting that a positive facial expression might have either added some new information or enhanced favourable features that were already perceived in the neutral face.

Following the assumptions made on the role of smiling in cooperative relationships, it was proposed that smiling would reduce perceived competitiveness in same-sex dyads. Contrary to that prediction, ratings of competitiveness were positively influenced by smiling only when men rated women's faces. Not only this result goes against the hypothesis that smiling would decrease competitiveness, but it is also at odds with the suggestion that women smile more in order to underline a socially imposed submissive role (Henley, 1977). This finding suggests, instead, that men might perceive smiling in women as a tendency to engage in social challenges.

The Duchenne smile had an impact on competitiveness judgements performed by males but not by females. The change in competitiveness ratings was significantly

greater for male than for female judges when the face showed a non-Duchenne smile, indicating that men more than women tend to interpret this type of smile as a sign of involvement in social competition. Similarly, the impact of smiling on men's ratings of competitiveness was considerably larger for faces with non-Duchenne smiles than for faces with Duchenne smiles. These findings combined with the fact that non-Duchenne smiles are easier to produce on purpose (Ekman & Friesen, 1982) suggest that men could perceive women who display these smiles as being more eager to obtain benefits through social means. The occurrence of this effect in men but not in women could result from the fact that males more than females tend to see social relationships in competitive terms (Baron-Cohen, 2003).

4.3. Smiling and Personality

Extroversion is one of the major personality dimensions and it has been included in all structural models of personality established so far (Eysenck & Eysenck, 1985; McCrae & Costa, 1989). The present study showed that smiling strongly influenced extroversion ratings made on faces. Moreover, extroversion was the only attribute for which smiling had a significant impact independently of the sex composition of dyads, indicating that, above all, human smiling could be a measure of sociability. In addition, the type of smile positively affected extroversion ratings, a finding that highlight the importance of the Duchenne smile as a social signal.

Relationships with extrovert people could be advantageous at the same time as deleterious, depending on one's social strategy. Extrovert people might potentially attract social benefits, but they are also more likely to be exposed to social danger. Therefore, given that extroversion is as much associated with fitness costs as with benefits (Nettle, 2005), the perception of this trait alone might not give sufficient information as to what consequences bonding with extrovert people could lead to. Instead, the combination of extroversion and agreeableness would be more valuable to detect because these two dimensions generally encompass most aspects of social relatedness (McCrae & Costa, 1989). Hence, it might be more advisable to engage interactions with extroverts who also score high on agreeableness, a trait negatively

related to hostility. The finding that smiling positively influenced the assessment of extroversion and agreeableness indicates that this facial expression could advertise the social style underlined by both personality dimensions.

Along with extroversion, agreeableness is seen as one of the major axes of interpersonal taxonomy (McCrae & Costa, 1989). This could result from the important advantage incurred by people who can correctly discern other's inclinations to "cooperate" or to "aggress", over people who cannot (Buss, 1991). The present study showed that smiling could be involved in that detection process, because agreeableness ratings were significantly affected by smiling (with the exception of male (sender) – female (receiver) dyads). The absence of effect on the ratings of men by women suggests that women's perception of agreeableness in men could depend on cues other than smiling. Finally, the overall effect of smiling on perceived agreeableness confirms earlier results on smile perception (Otta *et al.*, 1994, 1996), and partly supports the proposal that smiling and the non-human primate *silent bared-teeth* display have a similar social purpose in the display of non-hostile intentions (van Hooff, 1972; Waller & Dunbar, 2005).

Neuroticism is generally considered to be the single most important trait of human personality and it correlates with major aspects of functioning, including health, psychopathology, as well as job and marital satisfaction (Watson, 2001). Not only this dimension reflects a vulnerability to subjective distress and negative emotionality, but it also has stronger, clearer, and broader connections with psychopathology than any other personality traits (Clark & Watson, 1999; Widiger, Verheul, Van den Brink, 1999). Social bonds with neurotic individuals might not be the most valuables, as high scorers on that trait usually report greater marital insatisfaction and show greater instability in their relationships (Karney & Bradbury, 1995). The advertisement and detection of emotional stability (low neuroticism) might therefore be essential to the formation of alliances between people. This chapter's data showed that the only instances in which smiling had an effect on neuroticism ratings were when these ratings were performed by male judges, regardless of the sex of faces. Smiling faces received significantly lower scores on neuroticism when these were given by men,

whereas neuroticism judgements given by women were not affected by smiling. The assessment of emotional stability by men, but not women, could therefore be strongly influenced by smiling.

Interestingly, the type of smile had an impact on the effect of smiling on neuroticism judgements of male but not female faces. The decrease in neuroticism scores given to male faces was significantly larger when these faces were displaying a Duchenne rather than a non-Duchenne smile. This effect was absent in female faces. Furthermore, if we only consider faces with Duchenne smiles, the scores attributed to male faces changed significantly more than those attributed to female faces. This result strongly suggests that perceivers use Duchenne smiling as an indicator of emotional stability when judging male faces, but not necessarily female faces.

This sex difference indicates that men might be subject to a more stringent criteria when their emotional stability is under assessment. Research on personality reported that men are less homogenous than women on measures of neuroticism and agreeableness (Budaev 1999). Furthermore, neuroticism is positively related to the expression of anger (Watson & Clark, 1984) and to interpersonal conflicts (Rantanen *et al.*, 2005). These studies imply that there exist, within the male population, different strategies regarding the management of anger. Therefore, a greater variability in neuroticism within the male population, and the relationship between aggression and emotional stability might constitute strong selection pressures to accurately detect latent hostility in men. The present results suggest that smiling, in particular the Duchenne type, could be involved in the advertisement of emotional stability in men.

Overall, this chapter showed that smiling influenced the attribution of individual characteristics, which from an evolutionary point of view, are socially relevant. It also showed that the impact of smiling often depended on the sex composition of the sender-receiver dyad and it confirmed that men and women are not equally sensitive to the perception of facial displays. Interestingly, the difference between sexes was particularly striking in opposite-sex pairs, and it appeared to be more beneficial for women. Indeed, women smiling was particularly efficient at influencing men's ratings,

whereas men smiling had a weak impact on women's judgements. These findings suggest two interesting conclusions. The first is that women seem to be less vulnerable to the influence of smiling when doing social judgements, especially when it comes to evaluate men. This supports the evolutionary hypothesis that females are more selective in their relationships as a result of a stronger pressure to avoid potentially dangerous social partners (Grammer, 1989; Campbell, 2002). The second conclusion is that, in terms of social judgements, women can strongly benefit from smiling. The efficiency of smiling at changing women's image implies that they could profitably use this behaviour in inter-sexual relationships. This finding combined with the observation that women generally smile more than men (Hall, 1984; Hall & Halberstadt, 1986; LaFrance *et al.*, 2003) could be evidence for a social strategy based on self-presentation.

As far as the type of smile is considered, this chapter showed that the Duchenne smile could be crucial in interpersonal relationships that involve men, at the level of both sender and receiver. Indeed, men seem to use the Duchenne marker as an indcator of generosity when perceiveing other men, and it produced lower increases in competitiveness ratings. Moreover, men did considerably benefit from displaying Duchenne smiles when their emotional stability was under evaluation.

Although it was shown that smiling is linked to the perception of some personality traits, smiling does not necessarily function to advertise these traits in an absolute manner. In other words, a smile might not advertise an attribute more than another if the context in which it is perceived is irrelevant to the evaluation of the attribute in question. Consequently, this study identified situations in which smiling could have a significant impact on person perception, and situations in which it could not.

Finally, if it was shown that smiling affects the perception of individual traits, one cannot conclude that it does actually advertise any of these traits (in an honest or dishonest way), as data did not allow us to determine the relationship between smiling and the prevalence of the trait in the sender. The main concern was to see whether smiling could change trait perception and it did, in a sense that could be adaptive to the

sender. The question of whether the impact of smiling is also adaptive to the receiver will be the topic of the next chapter.

Chapter Five

SMILING AND LAUGHTER IN BARGAINING GAMES AND THE ADVERTISEMENT OF SOCIALLY RELEVANT DIMENSIONS

1. Introduction

It was discussed in the first chapter that a large part of social interactions in primates involves attempts to control and predict the behaviour of group members as well as to adapt one's own behaviour to that of other individuals (Dunbar, 1988). An abundant literature on the topic suggests that the relevant social information could be inferred through the perception of behavioural cues commonly referred to as social signals (Hinde, 1985; Eibl-Eibesfeldt, 1989). In addition, the meaning of these signals would be flexible and adapted to the situation (Markl, 1985; Grammer, 1989). Evolutionary principles imply that social signals function best when displayed in contexts that are likely to yield positive consequences for the sender, and to some extent, the receiver (Hinde, 1975; Maynard-Smith & Harper, 2003).

Among others, the situations that involve acquisition of resources should be important in the evolution of social behaviour because they often represent the contexts in which cooperation and conflicts occur between group members. For example, a situation where resources can be monopolised by a single individual often results in competition in which the winner can exclude the loser from the resource. On the other hand when resources are difficult to control by an individual alone, cooperation might give higher pay-offs than competitive contests. Therefore, the type of social interaction is clearly rooted in ecological conditions (Wrangham, 1980; van Schaik, 1989), and in many cases the outcome of such interactions has a direct or indirect impact on the reproductive success of individuals. Consequently, any behaviour that is likely to positively influence the outcome of such interaction will be selected for during evolution.

The functional use of facial displays in social interactions among primates is well documented (Andrew, 1969; van Hooff, 1972; Waller & Dunbar, 2005). Some authors suggested that the variety and flexibility of primates' facial displays do probably result from evolutionary pressures imposed by the intertwining between ecological factors and an ever increasing social complexity (Preuschoft & van Hooff, 1997). In fact, the flexibility of use of the *silent bared-teeth* display across primate species (including humans) seems to depend more on the type of social relationships brought about by particular ecological conditions rather than on phylogenetic aspects (Preuschoft & van Hooff, 1997). In particular, the mode of resource exploitation and the resulting dominance styles (cooperative vs. coercive) could determine the pattern of affiliative behaviours exchanged between individuals. This implies that the need for a cooperative exploitation of resources probably led to a greater interdependency between group members and resulted in even-handed exchanges. Preuschoft & van Hooff (1997) suggested that symmetry in social relationships would be reflected in a more balanced pattern of affiliative signalling between partners. As a result, one should expect individuals to display different patterns of smiling and laughter depending on the way a resource can be controlled and allocated. The sharing of resources can be formalised using standard experimental procedures that vary as to the modalities of sharing. These standard procedures are often called bargaining games.

1.1. Bargaining Games

Bargaining games are experimental protocols developed by economists to study human economic behaviour. These games usually involve the distribution of some amount of money between participants according to different modalities. Bargaining experiments include the 'Dictator Game' (Kahneman *et al.*, 1986), the 'Ultimatum Game' (Güth *et al.*, 1982), the 'Public Good Game' (Ledyard, 1995), the 'Trust Game' (Berg *et al.*, 1995), the 'Gift Exchange Game' (Fehr *et al.*, 1993), and the 'Third Party Punishment Game' (Fehr & Fischbacher, 2001*a*). Bargaining games are traditionally conducted in anonymous settings, i.e. the participants do not know whom they play with, and have no contact during the game. The experimental design is kept anonymous in order to control for the influence of social variables on economic behaviour. This design is

used as a benchmark from which the effect of playing repeatedly, communicating, knowing the other player, etc., can be compared (see Camerer, 2003 for methodological details). The present study is based on two of these games: the 'Dictator Game' and the 'Ultimatum Game'.

Dictator and ultimatum games are always played between two persons. In the dictator game, an individual is given the opportunity to share some money with the other individual (Kahneman *et al.*, 1986). The name of the game follows from the modalities with which the money is divided. In such games, the decision is taken by only one person, called the dictator, and the recipient has no say as to the amount of money he or she receives. In that respect, the power asymmetry between players is deemed to be rather large. In the ultimatum game, the two participants are advised to come to an agreement as to how some amount of money will be divided between them (Güth *et al.*, 1982). A proposer has to make an offer that the respondent must accept in order to receive the money. If the respondent refuses the offer, both participants obtain nothing. It thus requires the proposer to make a 'fair' offer that will be accepted by the respondent. Consequently, ultimatum games represent social situations that involve symmetry and fairness, as opposed to dictator games, situations in which selfish interests are expected to prevail.

The most important conclusion that has been drawn from hundreds of bargaining games conducted all over the world is that the outcomes of such experiments constantly violate the *selfishness axiom*, the assumption that individuals act rationally and seek to maximise their material gains and expect others to do the same (Henrich *et al.*, 2004). If people were to behave in a selfish manner, allocations in dictator games should typically be zero, and responders in ultimatum games should generally accept any offer that is above zero. However, most research in experimental economics showed that this is rarely the case (Henrich *et al.*, 2004). For example in dictator experiments with students, proposers generally allocate between 10 and 25 percent of the pie to recipients, with modal allocations distributed between 50 percent and zero (*ibid.*). Interestingly, when the experimenter states that he/she will not know about how much is shared between the players (in 'double-blind' experiments), about 70 percent

of the proposers give nothing, while the rest allocates between 10 and 20 percent of the total sum (Hoffman *et al.*, 1994). In ultimatum games, the typical distribution of offers shows that proposers are generally ready to share between 30 and 50 percent of the pie with their partners (Hoffman *et al.*, 1996), amounts that are considerably greater from what is observed in dictator games. This pattern of offers is believed to reflect the fact that responders usually reject amounts smaller than 20 percent of the pie about half the time (*ibid.*), therefore sacrificing their own money to punish a proposer who has not been fair.

The message that slowly emerged from these studies is that people have social preferences, they care about fairness and reciprocity, they act in a pro-social way and reward others who do so while punishing those who do not, even when these actions entail personal costs (Henrich *et al.*, 2004). The long-term evolutionary success of these non-selfish behaviours is likely to be related to mechanisms such as kin selection and reciprocal altruism, the latter of which has been used in the present thesis as a background to interpret the roles of smiling and laughter in social relationships.

Because bargaining represents socio-ecological conditions familiar to most humans, it should be relevant to affiliation and conflict. Bargaining situations are likely to involve aspects of cooperation, hierarchical relationships and personality advertisement. The outcome of bargaining games might depend on the individuals' social status, personality, and the type of relationship between players. It is reasonable to assume that the impact of interpersonal factors on bargaining is made possible via communication between the players. For example, Bohnet and Frey (1999) were able to demonstrate that when a recipient gives a short description of him or herself which the proposer hears, the allocations in a dictator game become more variable, and the average share rises to half of the pie. Because smiling is related to interpersonal aspects such as personality, dominance, and altruism, the influence of social factors on bargaining could be mediated by various forms of smiling and to some extent laughter. In other words, the relationship between smiling/laughter and interpersonal factors could determine how the resource is shared or held back.

1.2. Smiling and Status in Dyadic Interactions

Previous research failed to find any agreement on the relationship between status and smiling. Some studies found that smiling was associated with low power (Denmark, 1977; Deutsch, 1990) whereas other researchers found the opposite, i.e. that high-power people smile more than low-power people (Halberstadt *et al.*, 1988). Also, some studies showed that smiles were displayed equally often by dominant and subordinate individuals (Johnson, 1994; Kolaric & Galambos, 1995; Cashdan, 1998; LaFrance & Hecht, 1999) while some found mixed results (Dovidio *et al.*, 1988). Such discrepancies might result from the lack of a solid theoretical framework to explain why smiling would be associated with status. Furthermore, most of these studies ignored the importance of socio-ecological factors in the evolution of social behaviour.

As mentioned earlier, the distribution of resources in the environment could be particularly important in determining the pattern of competition-cooperation in a group. Indeed, the access to a concentrated resource could be controlled by an individual alone whereas the exploitation of more dispersed resources would require individuals to engage in cooperative organisation. Consequently, differences in dominance styles (de Waal, 1989a) are likely to originate in different ecological conditions (van Schaik, 1989; Verhencamp, 1983; Wrangham, 1980). This implies that when resources can be controlled by a single individual, the outcome of a dyadic interaction over that resource often depends on the status relationship between the protagonists. On the other hand, when the allocation of resources depends on a common agreement between partners, hierarchical relationships should be kept to a lower level and status should determine the outcome of the interaction in a lesser extent. These two types of situations will be implemented in the two bargaining games presented earlier.

1.3. Power Asymmetry, Bargaining Games, and Affiliative Behaviour

In bargaining games, asymmetry in the control of resources creates an asymmetry in social relationships, as the resource holders (dictators, or proposers) have the

opportunity to decide the 'fate' of that resource whereas the non-holders (the recipients) have to find ways to get hold of it. In a dictator game, the power asymmetry between participants is large because the decision to share the resource entirely depends on the choice of one individual, i.e. the dictator. In this particular context, the dictator has a dominant status because he/she fully controls the outcome. It is proposed that such an asymmetry in power is likely to result in an asymmetry in affiliative behaviours. In fact, if smiling is used to obtain a resource that is controlled socially, the individual who has no control over that resource should be expected to smile more as attempts to obtain a share. In that sense, smiling could be seen as an attempt to 'control' the resource through another individual. On the other hand, the person who controls the resource should smile less, because his/her access to the resource does not depend on the other individual. It is important to note that this strategy applies only when the individual who tries to obtain the resource has peaceful intentions towards the other, or when a physical challenge over the resource is perceived as being too dangerous.

In the ultimatum game, however, the asymmetry between participants is less pronounced. The rules of ultimatum games state that the amount obtained depends on the decision of both partners, so the power asymmetry is drastically reduced in comparison to dictator games. Nonetheless, the person who decides the amount to share is still in a position where he/she can potentially obtain a larger part of the pie and retain more of the resource for him/her. In that respect, there is still a slight asymmetry in roles and the proposer is in a dominant position. The amount offered in ultimatum games probably depends on the proposer's perception of the likelihood that the respondent will accept the offer (Hoffman *et al.*, 1996). Similarly, the respondent's approval relies on his/her perception of the fairness of the proposal. It is proposed here that both types of perceptions depend on the non-verbal signals displayed by the participants (in our case smiling and laughter). On the one hand, the respondent's smiles while bargaining might influence the amount offered by the proposer; and on the other hand, the proposer's smiles might determine the amount accepted by the respondent. In other words, respondents might be led to accept 'unfair' offers made by smiling proposers whereas proposers might be inclined to make fairer offers to smiling

recipients. Consequently, the pattern of smiling is expected to be more balanced in ultimatum games than in dictator games.

It is also expected that laughter would be used more frequently in bargaining situations as attempts to affect the other's tendency to share the money, or accept a particularly 'unfair' deal. In that respect, voiced laughter could be important in bargaining contexts, as it has been shown to induce positive emotion, hence a more favourable attitude in the receiver (Bachorowski & Owren, 2001). As it is the case for smiling, the asymmetry in the patterns of laughter should match the power asymmetry between participants, i.e. there should be large differences between proposers and recipients in dictator games, whereas individuals in ultimatum games should laugh equally often.

1.4. Smiling, Personality, and Intentions

It was discussed in chapter four that information about the personality of other group members might be crucial for people's adaptation to the social world. According to evolutionary theory, personality dimensions are a set of dispositions underlying adaptive strategies that people use to achieve reproductive goals (Buss, 1991). In that sense, personality traits represent the diversity of the social background to which people have to adapt, and could therefore provide information to answer adaptive questions such as whom to mate with, or whom to rely on in social alliances (Buss, 1991). If personality traits are stable overtime, knowing others' personality could help conveniently adjust one's behaviours and decisions during crucial interactions with them. It follows that the evolution of mind-reading abilities might have been driven by advantages resulting from accurate predictions about people's personality and behavioural style. Personality advertisement could have, in turn, become advantageous because it would have motivated people to invest resources in a particular relationship. Consequently, any social behaviour serving that purpose could have been selected for during evolution. Data presented in chapter four suggested that smiling could be a good candidate for personality advertisement.

If hierarchical relationships and the personality of individuals might influence the type, frequency, and duration of smiling; the proximate goals of the people involved are also important aspects to consider. For example, an interest in the resource could enhance the effect of the status asymmetry as it could amplify attempts to keep, or to acquire the resource. Besides, an interest in the partner or in the relationship in general could also affect the way resources are allocated, independently of the social status or the personality of the participants. The will to foster or maintain a fair relationship or to please the partner could overwhelm the possible effect of personality or power asymmetry on the decision to share the resource. Therefore the quality of the relationship between the players, as well as their personal intentions towards each other should be taken into consideration.

1.5. Aims

The roles of smiling and laughter in dictator and ultimatum games have not been investigated so far, and it is believed that non-verbal signalling is important to such negotiations. This chapter will first concentrate on the roles of smiling and laughter in the sharing of resources in dyadic interactions between friends (*Part 1* in the results section). It is expected that smiling and laughter will occur at higher rates in bargaining as opposed to control situations, and that these rates will be affected by the roles played by individuals in the experimental games.

The second objective of this chapter follows from the results presented in chapter four. It was found that smiling affects the perception of individual traits such as attractiveness, generosity, health, agreeableness, extroversion, openness to experience, and to some extent, neuroticism. The role of smiling in social relationships could therefore be connected to the way people perceive each other, and smiling could work by modifying a person's social image. Given the importance of social judgements in the management of relationships (i.e. social decisions made by people are certainly influenced by what people think of each other), the effect of smiling could be a crucial element in the chain of social consequences that ultimately leads to increased reproductive success.

If the previous chapter showed that smiling could be adaptive for the *sender* of the signal, what the data did not show is whether the *perception* of smiling is also adaptive, i.e. if the *receiver* also benefits from doing a given social judgement. There are some hints as to the presence of a selective mechanism responsible for the perception of different types of smile. Indeed, it was shown that faces with Duchenne smiles received higher scores on generosity and extroversion than faces with non-Duchenne smiles. Although this is evidence that perceivers are sensitive to variations in the signal, it does not tell us whether the signal actually reflects the prevalence of the trait in the sender. In other words, is smiling a honest indicator of what people perceive? This question will be addressed in the present chapter (*Part 2* in the results section).

2. Method

2.1. Participants

The study took place at the Ludwig-Boltzmann-Institute for Urban Ethology, hosted by the department of Anthropology at the University of Vienna. Participants were recruited via an advert placed on the vacancy page of the university website. Sixty pairs of friends were requested to come to the institute to participate in a study investigating social relationships. Participants were from a variety of backgrounds (students and non-students) and were aged between 18 and 30 years old. Pairs were composed of either same-sex or mixed-sex individuals and it was specified that neither romantic couples nor pairs of relatives could take part in the study. Participants were given a 'show-up' fee of €5 plus a portion of the money to be shared in a bargaining game (€40).

2.2. Material

A selection of questionnaires was handed to the participants at different times during the experiment in order to provide self-reported measures of emotion, personality,

quality of friendship between participants, and altruism. Background information about the participants were also collected with a questionnaire. These questionnaires are briefly presented in this section and can be found in *Appendix 3* (with the exception of the *NEO-Personality Inventory revised*).

Emotion was measured using 7 scales on which participants had to report their feelings of anger, happiness, fear, sadness, surprise, disgust, and relaxedness. Participants were presented a 10-cm line for each emotion (one end labelled 'not at all', and the other end 'very much'). They were asked to tick the line at the spot that corresponded best to their current feeling. The distance in centimetres between the origin of the line and the indicated spot constituted the self-reported measure of emotion.

Participant's personality was assessed with the German revised version of the *NEO-PI* personality inventory developed by Costa and McCrae (1992*a*). The *NEO-PI-R* contains 240 items that can be grouped into five factors representing the basic personality dimensions: agreeableness, conscientiousness, extroversion, neuroticism, and openness to experience. Each item describes a specific situation and people have to indicate to which degree they identify with that situation. The rating of each item is made on a 5-point scale ranging from 'not at all' to 'very much'. Responses are then aggregated following a standard procedure (Costa & McCrae, 1992*a*) and each participant finally receives a score from 1 to 5 for each of the major personality dimensions.

The quality of friendship was measured using a self-made questionnaire that contained attributes deemed important in friendship. In the questionnaire, participants were asked to rate their friend on each item using a 10 cm line (same procedure as for self-reported emotion). The friendship questionnaire included items such as 'how often do you see your friend?', 'how nice are encounters with your friend?', 'how often do you speak of intimate things with your friend?', 'how much do you like your friend?', 'how reliable is your friend?', etc. The scale also included an item aimed at measuring altruistic inclinations toward the friend: "what percentage of your salary would you give to your friend would he/she experience financial problems?". The friendship questionnaire

also contained items aimed at measuring the dominance relationship between the participants and the interest in sexual and romantic relationship with the friend.

The participant's general dispositions to altruism were further assessed with the questionnaire developed by Johnson and colleagues (1989), a scale that contains 56 items measuring the amount of instances that an individual has given up time, effort, goods, status, and safety in order to help others. Participants were asked to report how often they performed each act described in the statement from 1 (never) to 5 (very often), how often they have been the recipient of such acts, and how important are these acts to them from 1 (not important at all) to 4 (very important). These measures showed high internal consistency with coefficient alpha ranging between 0.89 and 0.95 across seven different cultures. In addition, test-retest reliability over a two-week period was of 0.94 (Johnson *et al.*, 1989). The 'Altruism Scale' includes 20 items from the 'Self-Report Altruism Scale' (Rushton *et al.*, 1981), items that were shown to be internally consistent across 5 samples.

Because the 'Altruism Scale' asks people to recall the number of altruistic acts they have performed in the past, it is believed to be less susceptible to deceptive responding than a scale that would ask the person to report whether or not he/she would behave altruistically in a hypothetical situation (Romer *et al.*, 1986). Indeed, Johnson *et al.* (1989) found that the 'Altruism Scale' was poorly correlated to a subscale of the 'Eysenck Personality Questionnaire' that measures lie (Eysenck *et al.*, 1985), indicating that people who are prone to lying do not necessarily report that they were more altruistic in the past. In addition, the 'Altruism Scale' was not significantly correlated to the 'Marlowe-Crowne Social Desirability Scale' (a measure of deceptive responding, Crowne & Marlowe, 1960), suggesting that participants who usually attempt to appear 'perfect' in front of the experimenter do not report more altruistic acts (Brown *et al.*, 2003). Interestingly, self-reported altruism was correlated to a measure of intrinsic religiosity (attainment of a higher level of morality, Allport & Ross, 1968) but not to extrinsic religiosity (seeking social support and personal benefits) (Johnson *et al.*, 1989). All these things considered, the 'Altruism Scale' should provide a valid measure of altruistic dispositions.

The experiment was conducted in two areas that will be named here the 'questionnaire area' and the 'experimental room'. The questionnaire area consisted of a large corridor where two tables and chairs could be placed on each side of a large wall that was conveniently used to prevent communication between participants while they were filling out questionnaires. The experimental room was a small room where two comfortable seats were arranged at an angle of 90 degrees in order to minimise discomfort while interacting (Argyle, 1988). The layout of the experimental room is illustrated in *Figure 5.1*. Digital video cameras were concealed inside the room at three different locations in order to allow the filming of each participant's face as well as the overall context of the interaction. For the sake of this chapter, the analysis only includes the footage obtained from one video camera, a Panasonic NV-GS280. Sound was recorded through the built-in microphone of the same video camera.

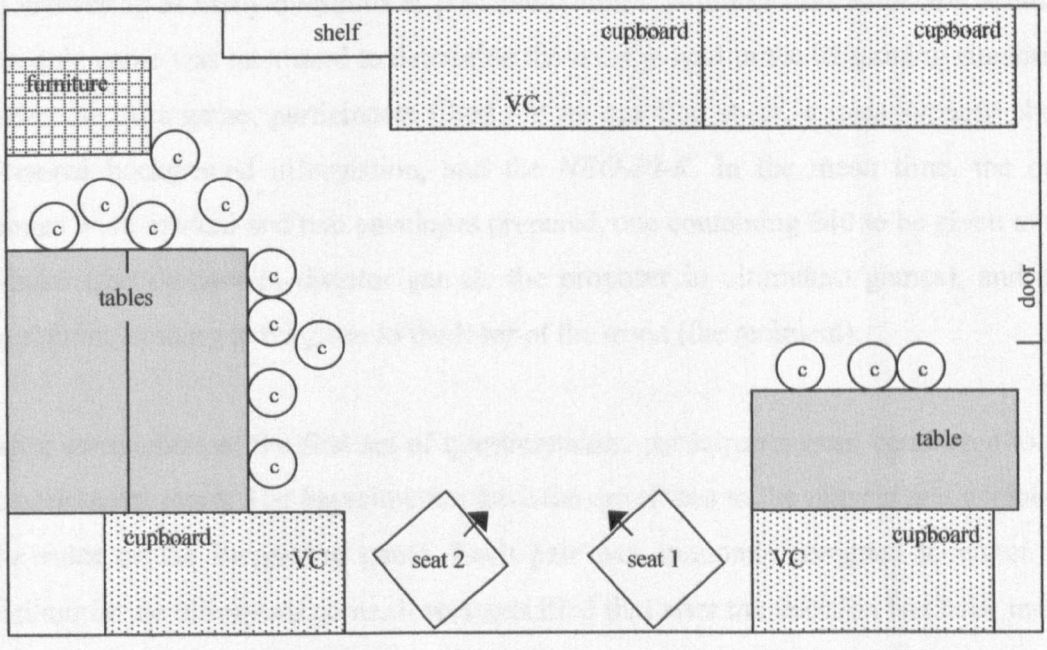


Figure 5.1. Layout of the experimental room. Key: VC: video camera, c: chair. The arrows indicate seating orientation.

2.3. Procedure

Participants were welcomed by the experimenter, who led them to the experimental room where he explained the procedure of the experiment (that they would fill out questionnaires and participate to some games). The experimenter then asked the participants to think of pseudo names that they would use during the experiment, pseudo names that should be chosen after famous pairs in history, legend, cinema, science, etc. (e.g. David & Golliath, Starsky & Hutch). The experimenter then left the room for 5 minutes to let them decide on these names. The participants were filmed during this period of time, which constituted the control interaction.

The experimenter came back 5 minutes later and took the participants in the questionnaire area, where they were first asked to complete a quiz game that consisted of answering as many questions as possible within a 5-minute time limit (the result of the quiz game was later used to determine the roles played in the bargaining situation). After the quiz game, participants filled out an emotion sheet, a questionnaire about personal background information, and the *NEO-PI-R*. In the mean time, the quiz games were marked and two envelopes prepared, one containing €40 to be given to the winner (the dictator in dictator games, the proposer in ultimatum games), and one containing nothing to be given to the loser of the trivia (the recipient).

After completion of the first set of questionnaires, participants were conducted to the experimental room. The experimenter gave the envelopes to the players and explained the rules of the bargaining game. Each pair was randomly assigned to either the dictator or the ultimatum game. It was specified that after the decision has been made, the money should be placed accordingly in the envelopes that had to be sealed and placed in a box located inside the room. The box would be opened by a different person than the experimenter. The bargaining game was filmed for a maximum period of five minutes, and this constituted the bargaining interaction.

When the game was over, the participants were conducted to the questionnaire area, and were asked to fill out the second set of questionnaires, including an emotion sheet,

the friendship questionnaire, and the 'Altruism Scale'. When the questionnaires were completed, participants were conducted to another person who paid them[5], and debriefed them about the experiment. Finally, participant signed a consent form to authorise the use of their personal data and video for scientific and educational purposes.

2.4. Behaviour Analysis

Four types of smiles were recorded, Duchenne and non-Duchenne smiles (see chapter 4), as well as open and closed smiles (see chapter 3). Smile categories were not exclusive of each other but represented two dimensions of smiling: cheek raise (also known as the Duchenne marker) and mouth opening. Smile frequencies were transformed into a rate per minute[6]. Smiles that co-occurred with laughter episodes were not included in the analysis, for the reason that their durations were more difficult to specify. Laughter was also recorded and classified in two categories: voiced and unvoiced. To be counted as a laugh, the episode had to include more than one note, or exhalation.

The use of digital video allowed a rather accurate coding of smile durations, as onset and offset times could be precisely determined when playing the video frame by frame (one frame = 0.04 sec). Because smiling does not always show a continuous offset, (i.e. a smile can vary in intensity before it completely disappears from the face) a new smile was recorded each time the lip corners were observed rising after a decrease in intensity. Therefore, gradual increases in smile intensity were not recorded as separate smiles. This coding procedure represented a good compromise between the issues of recording over elongated smiles (and thereby underestimate frequency) and recording too many short smiles (and thereby overestimate frequency). Because the onset and

[5] For the participants who played to the ultimatum game, the recipient was asked if he/she accepted the sum of money that was placed in his/her envelope before the payment was made.

[6] Whenever these rates did not follow a normal distribution, they were transformed using the square root function for statistical analyses.

offset of laughter episodes were rather difficult to determine, the duration of laughter was not taken into account.

Continuous focal sampling was performed on the individual who was sitting on 'seat 1' (see *Figure 5.1*). The duration of samples depended on the period of time needed to complete the bargaining game. For the experimental interaction, sampling began as soon as the experimenter left the room, and stopped when the envelopes were sealed and placed inside the box. For the control interaction, a sampling period was randomly selected within the five-minute waiting time, and lasted as long as the bargaining game did. For example, if the participants needed 90 seconds to share the money, a 90-second control period was randomly selected within the five-minute waiting time. The total observation time for the control and experimental conditions was 130.93 minutes. The average duration of a sample was 81.83 sec. (SD = 47.27).

3. Results

Part One: Smiling and Laughter in Bargaining Games

Results of the bargaining games show that money was shared evenly in 92% of cases, independently of the type of game (dictator or ultimatum). Only 5 games out of 60 did not follow that pattern. Interestingly, three of the five instances in which the money was not shared equally between players did not follow the traditional pattern usually observed in bargaining experiments. For example, one game saw a dictator giving the entire amount of money to the recipient, though the average offer in dictator games varies between 10 and 25% (Henrich *et al.*, 2004). Odd outcomes were also observed in ultimatum games when one recipient accepted an offer of zero, or when one proposer made an offer of €40 (100% of the pie). Two games, however, gave results compatible either with the *selfishness axiom* (one dictator allocated €1 to her friend, i.e. 0.025% of the total) or with general outcomes of ultimatum games (one recipient accepted an offer of 25% of the pie). Overall, the outcome of 97% of the bargaining games derived from what is generally observed in experiments conducted in

anonymous settings, indicating a strong effect of either the face-to-face interaction, or friendship.

3.1. Smiling, Laughter, and Bargaining

A repeated measure analysis of variance was computed to test whether smiling rates differed between the control and the bargaining situations. The design was 2 × 2 × 2, with sex of focal and sex of friend as between-subject factors, and experimental condition as within-subject factor. The dependent variables were the frequencies of non-Duchenne, Duchenne, and open smiles (rates per minute[7]). Multivariate tests showed a strong effect of experimental condition, $F(3, 42) = 5.71$, $p = .002$, indicating that smiling rates were significantly affected by the experimental condition. There was no effect of sex of focal, $F(3, 42) = 0.29$, $p = .83$, nor sex of partner $F(3, 42) = 0.58$, $p = .63$, on smiling rates. Interestingly, univariate tests revealed that the experimental condition had a significant impact on Duchenne smiles and open smiles, but not on non-Duchenne smiles (*Table 5.1*). These results are illustrated in *Figure 5.2*.

Table 5.1. Means (and standard deviations) of smiling rates per minute in the control and bargaining interactions. $^{*}p < .01$, $^{**}p < .001$

Smile Type	*Control, n=48*	*Bargaining, n=48*	*F(1, 44)*	*d*
non-Duchenne smile	1.80 (1.66)	2.08 (1.89)	0.70	0.16
Duchenne smile	2.11 (2.02)	3.56 (2.26)	17.18**	0.67
Open smile	2.96 (2.82)	4.29 (3.03)	8.04*	0.45
Closed smile	0.94 (1.34)	1.35 (1.83)	-	-

[7] Because closed smile rate did not follow a normal distribution, it was analysed separately using non-parametric statistics.

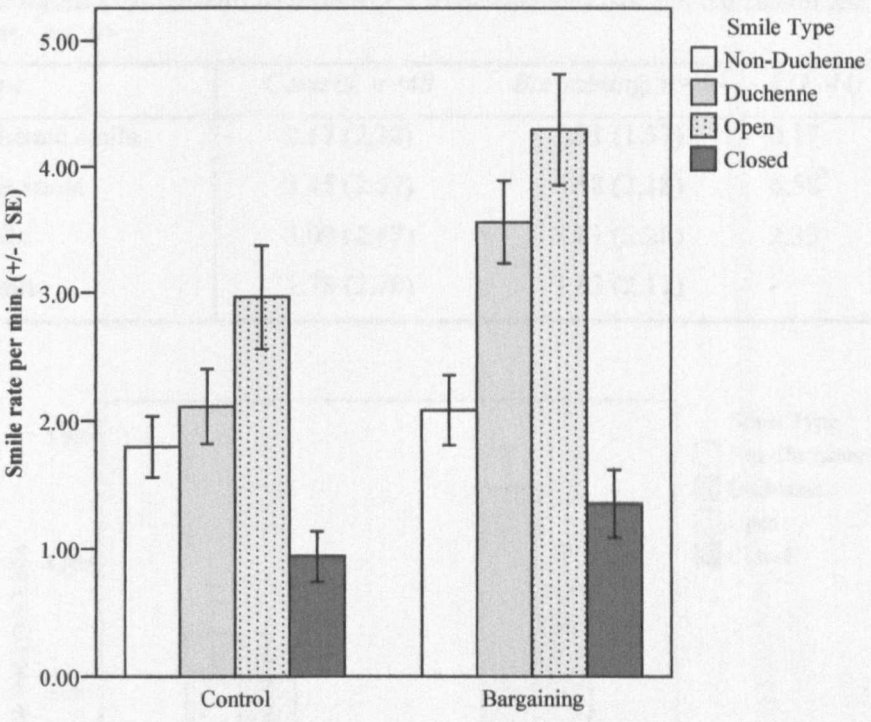


Figure 5.2. Effect of bargaining context on different types of smile (mean rate per min.)

The same analysis was repeated with smile durations (sec.) as dependent variables. This time multivariate tests showed a weak impact of experimental condition, $F(3, 42) = 2.30$, $p = .09$. There was no main effect of sex of focal, $F(3, 42) = 0.33$, $p = .80$, nor sex of partner $F(3, 42) = 0.42$, $p = .74$ on smile durations. Nonetheless, univariate tests revealed that the experimental condition had a significant impact on the duration of Duchenne smiles, but neither on that of open, nor non-Duchenne smiles (*Table 5.2*). This suggests that Duchenne smiles displayed in the bargaining condition were on average longer than those displayed in the control interaction (*Figure 5.3*).

Table 5.2. Means (and standard deviations) for smile durations (sec.) in the control and bargaining interactions. $^{*}p < .05$

Smile Type	*Control, n=48*	*Bargaining, n=48*	*F(1, 44)*	*d*
non-Duchenne smile	2.17 (2.38)	1.91 (1.57)	0.17	0.12
Duchenne smile	3.45 (2.57)	4.58 (2.18)	6.58*	0.47
Open smile	3.09 (2.47)	3.81 (2.20)	2.33	0.30
Closed smile	1.78 (2.70)	1.83 (2.11)	-	-

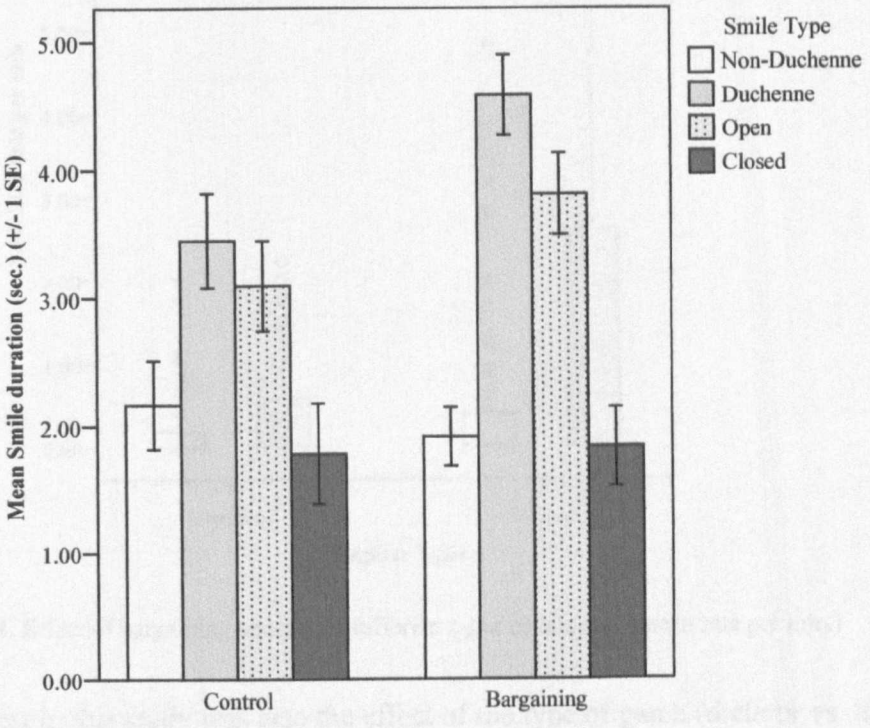


Figure 5.3. Effect of bargaining context on smile durations (sec.)

Because closed smiles and laughter rates did not follow normal distributions, the effect of experimental condition on these variables was investigated using the non-parametric equivalent of the paired-sample *t*-test, the Wilcoxon's Signed Rank Test. Results showed that closed smile rates were unaffected by the experimental condition, $z = -1.37$, $p = .17$, indicating that people displayed similar rates of closed smiles in the control (*Mdn* = 0.39) and in the bargaining interactions (*Mdn* = 0.81). Unvoiced laughter did not differ between conditions either, $z = -1.04$, $p = .30$, as people laughed equally often in the control (*Mdn* = 0) than in the bargaining interaction (*Mdn* = 0). On the other hand, voiced laughter was significantly affected by the experimental

condition, z = -3.24, p = .001. Voiced laughter rate per minute was higher in the bargaining (*Mdn* = 0.61) than in the control situation (*Mdn* = 0), r = -.33. Results relative to laughter are presented in *Figure 5.4*.

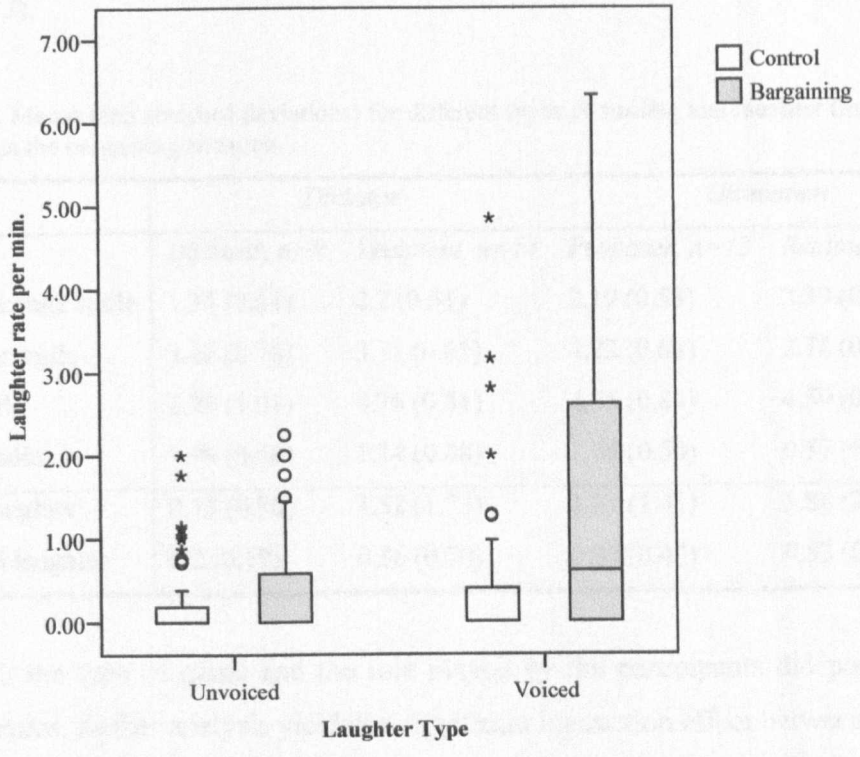


Figure 5.4. Effect of bargaining context on different types of laughter (mean rate per min.)

Of interest in this study was also the effect of the type of game (dictator vs. ultimatum) and the role played in the bargaining interaction (dictator or proposer vs. recipient). A 2 × 2 univariate ANOVA was conducted for each type of smile, with 'type of game' and 'role' as between-subject factors. There was no effect of game, $F(1, 44) = 0.85$, $p = .36$, nor role, $F(1, 44) = 0.88$, $p = .35$, on non-Duchenne smile *rate*. Similarly, Duchenne smile *rate* was not affected by game, $F(1, 44) = 0.01$, $p = .92$, nor role, $F(1, 44) = 0.76$, $p = .39$. Non-significant results were also found for open smile *rates* (game: $F(1, 44) = 0.79$, $p = .38$, role: $F(1, 44) = 1.28$, $p = .26$).

The effects of 'type of game' and 'role' on closed smile rates were investigated using Mann-Whitney *U*-test. Although the type of game did not significantly affect closed smile rates, $U = 236$, $z = -1.09$, $p = .27$, the role played in the game had a marginally

significant impact, $U = 199$, $z = -1.85$, $p = .06$. This suggests that resource holders (dictators and proposers) showed higher rates of closed smiles (*Mdn* = 1.25) than recipients (*Mdn* = 0.42). With the exception of closed smiles, smiling *rates* appeared to be unaffected by the type of bargaining games and the role played in those games (*Table 5.3*).

Table 5.3. Means (and standard deviations) for different types of smiling and laughter (rate per min.) displayed in the bargaining situation.

Game	*Dictator*		*Ultimatum*	
Role	*Dictator, n=9*	*Recipient, n=14*	*Proposer, n=13*	*Recipient, n=12*
Non-Duchenne smile	1.34 (0.64)	2.2 (0.51)	2.19 (0.53)	2.39 (0.55)
Duchenne smile	3.42 (0.76)	3.71 (0.61)	4.22 (0.63)	2.78 (0.67)
Open smile	2.79 (1.01)	4.76 (0.81)	4.55 (0.84)	4.59 (0.88)
Closed smile	1.98 (0.60)	1.14 (0.48)	1.86 (0.50)	0.57 (0.52)
Voiced laughter	0.75 (0.98)	1.52 (1.73)	1.21 (1.41)	1.88 (2.15)
Unvoiced laughter	0.2 (0.59)	0.36 (0.70)	0.35 (0.44)	0.53 (0.81)

Although the type of game and the role played by the participants did poorly affect smiling *rates*, further analysis yielded a significant interaction effect between these two variables on the *duration* of Duchenne smiles, $F(1, 44) = 4.09$, $p < .05$, indicating that the effect of role on Duchenne smile's duration depended on the type of game. Duchenne smiles displayed by recipients in dictator games were on average longer ($M = 4.94$, $SD = 2.56$) than those given by dictators ($M = 3.26$, $SD = 1.08$), $t = 2.18$, $p = .04$, $d = 0.86$, whereas this difference was not present in ultimatum games, $t = 0.58$, $p = .56$. In addition, Duchenne smiles shown by proposers ($M = 5.10$, $SD = 2.15$) were significantly longer than those shown by dictators ($M = 3.26$, $SD = 1.08$), $t = 2.64$, $p = .02$, $d = 1.08$; while Duchenne smiles displayed by recipients were equally long regardless of the game in which they were involved, $t = 0.37$, $p = .71$ (*Figure 5.5*). The interaction 'type of game' × 'role' on the duration of non-Duchenne smiles was non-significant, $F(1, 44) < 0.001$, $p = .99$.

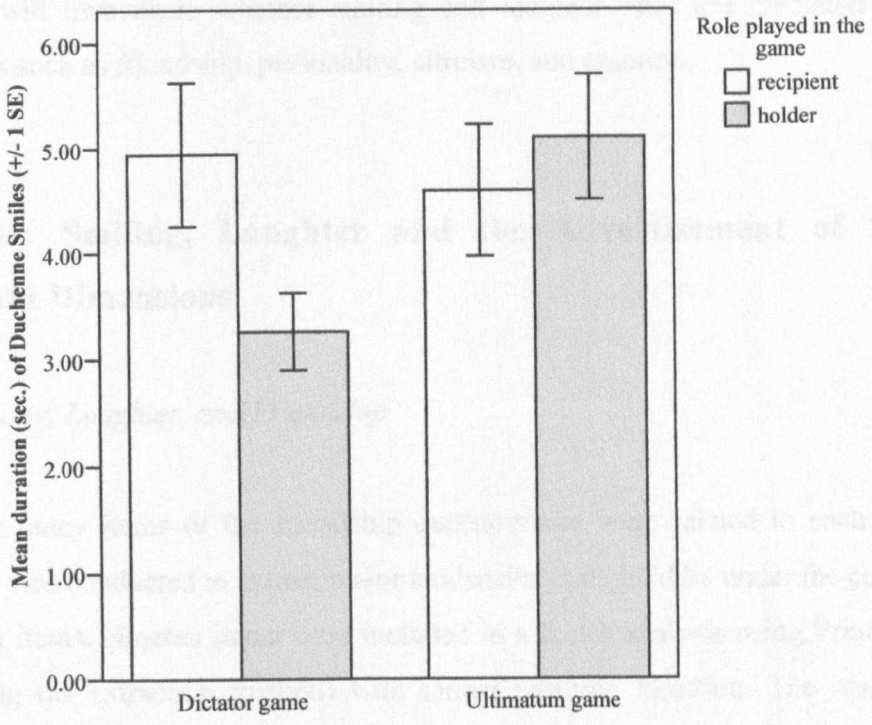


Figure 5.5. Mean duration of Duchenne smiles (s) according to the type of bargaining game and the role played in the game.

For the reasons explained earlier, the impacts of game and role on laughter rates were analysed by means of non-parametric tests. A Mann-Whitney *U*-test showed no effect of game on voiced, $U = 269$, $z = -0.4$, $p = .69$, nor unvoiced laughter, $U = 233$, $z = -1.34$, $p = .18$; nor was there any effect of role on voiced, $U = 238$, $z = -1.04$, $p = .3$, nor unvoiced laughter, $U = 269.5$, $z = -0.41$, $p = .68$. Means relative to laughter rates are presented in *Table 5.3*. These results indicate that people laughed at similar rates independently of whether they were playing dictator or ultimatum games, and regardless of the roles played in those games.

On the whole, this section showed that Duchenne smiles and voiced laughter were significantly affected by the experimental condition. On average, participants displayed more of those behaviours when the interaction involved the sharing of money. In addition, the type of bargaining game and the role played by participants did affect the duration of Duchenne smiles in a way that is compatible with the proposal that asymmetry in the relationship would produce asymmetry in smiling. The next

section will investigate whether smiling and laughter rates are mediated by other variables such as friendship, personality, altruism, and emotion.

Part II: Smiling, Laughter and the Advertisement of Socially Relevant Dimensions

3.2. Smiling, Laughter, and Friendship

Because many items of the friendship questionnaire were related to each other, an analysis was conducted to extract major tendencies that could lie under the correlations between items. Nineten items were included in a factor analysis using Principal Axis Factoring (as extraction method) with Direct Oblimin Rotation. The analysis was conducted on the 120 participants who completed the friendship questionnaire. Four factors with an eigenvalue greater than 1 were extracted, and it is likely that they represent the major dimensions of friendship covered by the questionnaire (*Table 5.4*). Items with weak loadings on all the factors were dropped and not included in subsequent analyses. Likewise, two factors were removed from the analysis because they contained an insuffucient number of items. Items with high loadings on a factor were aggregated into a single variable that was subsequently used in correlation and regression analyses.

Table 5.4. Summary of the friendship questionaire. Factors extracted with Principal Axis Factoring, and the items that load on them. Eigenvalues and factor loading values are shown in brackets. $n = 120$

Factor	*Items*
Closeness (4.21)	Talking about personal concerns (.74)
	Acquaintance with friend (.75)
	Feelings of closeness to friend (.62)
	Affection for friend (.55)
	Balance in the relationship (.51)
	Activities shared with friend (.46)
Qualities (1.72)	Generosity (.75)
	Reliability (.70)
	Trustworthiness (.74)

Correlations were computed to evaluate the associations between friendship variables and smiling. Correlations relative to closed smiles are non-parametric (Spearman). The control and bargaining situations were analysed separately. Results are presented in *Table 5.5* and show that, overall, friendship was poorly associated with smiling in the control and the bargaining interaction. The only significant association was a negative correlation between open smile duration in the bargaining game and the friend's qualities (*Table 5.5*). This indicates that people who had a poor opinion of their friend (in terms of generosity, reliability and trustworthiness) tended to show elongated open smiles.

Table 5.5. Pearson correlations between smiling and friendship variables. Key:[a] control interaction, [b] bargaining interaction, [c]Spearman correlations, $^{*}p < .05$, $n = 48$.

	Closeness	*Qualities*	*Dominance index*
Smile duration[a]			
Non-Duchenne	.19	.15	-.02
Duchenne	.17	.05	-.03
Open	.15	.06	-.002
Closed[c]	.10	.12	.002
Smile rate[a]			
Non-Duchenne	.09	.19	-.10
Duchenne	.03	-.19	.04
Open	-.05	-.14	-.01
Closed[c]	.15	.16	-.02
Smile duration[b]			
Non-Duchenne	.08	.17	-.17
Duchenne	-.24	-.23	.05
Open	-.23	-.30*	.08
Closed[c]	-.02	.08	-.15
Smile rate[b]			
Non-Duchenne	-.11	.001	-.13
Duchenne	-.11	.07	.16
Open	-.07	.09	.16
Closed[c]	.02	.00	-.15

The influence of friendship on laughter rates was investigated using a logistic regression, with the occurrence of laughter (coded 'yes' or 'no') as dependent variable. Predictors were the sex of participants, the two factors underlying friendship, and the dominance index. The probability of observing one episode of voiced laughter during the control interaction was significantly affected by the model (*Table 5.6*), which explained between 18% and 26.1% of the variance with an accuracy of 79.2%.

Table 5.6. Omnibus Tests of Model Coefficients for stepwise logistic regression (*Forward:LR*). Predictors are sex of focal, sex of friend, the two factors extracted from the factor analysis (*Table 5.4*), and the dominant index. Key: [a]control interaction, [b]bargaining interaction. [c]Non-significant χ^2 values were obtained with the 'enter' method. $^{*}p < .05$, $^{**}p < .01$

Criterion	*Chi square*[c]	*df*	*Cox & Snell* R^2	*Nagelkerke* R^2
Voiced laughter[a]	9.52**	2	.18	.26
Unvoiced laughter[a]	4.08	5	–	–
Voiced laughter[b]	1.96	5	–	–
Unvoiced laughter[b]	3.82	5	–	–

The regression coefficients showed that the sex of the focal and the qualities attributed to the friend could reliably predict the likelihood of observing vocalised laughs in the control interaction (*Table 5.7*). Both predictors increased the odds that vocalised laughter would occur, indicating that on the one hand voiced laughter was more likely to happen when the focal was a woman, and on the other hand an increase in the judgment of the friend's qualities (reliability, generosity, trustworthiness) would increase the odds of observing an episode of voiced laughter. This effect was present when people were interacting in the control situation only, as other models were non-significant (*Table 5.6*).

Table 5.7. Regression coefficients for the model relative to voiced laughter in the control situation.

Predictors	*B*	*SE*	*Wald* χ^2	*p*	*EXP (B)*
sex of focal	1.85	0.77	5.69	.017	6.37
C2: qualities	0.60	0.30	3.99	.046	1.81
Constant	-5.25	2.56	4.2	.040	.005

3.3. Smiling, Laughter, and Personality

The relationship between smiling and personality was first investigated using non-parametric Spearman correlations (scores on the *NEO-PI-R* were not normally distributed). Results are presented in *Table 5.8a* and show little association between smiling and personality. Agreeableness was the only dimension associated with smiling, as it was positively correlated with non-Duchenne smile *rate* in the control interaction, and with the *duration* of Duchenne smile in the bargaining condition.

Table 5.8a. Spearman correlations between smiling and scores on Neuroticism (N), Extroversion (E), Openness to experience (O), Agreeableness (A), and Conscientiousness (C). Key: [a]control interaction, [b]bargaining interaction, $^{*}p < .05$

	N	*E*	*O*	*A*	*C*
Smile duration[a]					
Non-Duchenne	-.13	-.02	-.02	.15	.23
Duchenne	-.11	.13	-.04	.24	.12
Open	-.17	.18	-.03	.14	-.08
Closed	-.07	-.18	.02	-.11	.25
Smile rate[a]					
Non-Duchenne	-.06	-.22	-.02	.36*	.22
Duchenne	.17	.02	.03	.23	.16
Open	-.07	-.05	-.01	.25	.04
Closed	.07	-.21	.06	.01	.27
Smile duration[b]					
Non-Duchenne	-.04	.05	-.02	.22	-.01
Duchenne	.14	.07	.16	.31*	.06
Open	.10	.07	.01	.17	.05
Closed	.14	.10	.002	.04	-.13
Smile rate[b]					
Non-Duchenne	-.09	.07	-.04	.15	-.03
Duchenne	-.09	.04	-.15	.15	-.005
Open	-.04	.04	-.06	.24	.04
Closed	.07	.01	-.10	-.08	-.08

The effect of the five major personality dimensions on smiling was further investigated using stepwise regression analyses. It was found that agreeableness and extroversion were the only personality dimensions that had an impact on smiling. The *overall* duration of Duchenne smiles (in the control and the bargaining interaction) was positively affected by agreeableness, $F(1, 46) = 5.31$, $p = .03$, $\beta = 0.32$, indicating that these smiles were on average longer when displayed by participants who scored high on agreeableness (not in table). As shown in *Table 5.8b*, agreeableness was also positively related to non-Duchenne and to open smile rates, suggesting that people with agreeable dispositions showed increased rates of non-Duchenne smiles and open

smiles. Surprisingly, extroversion was negatively related to non-Duchenne smile rates, these smiles being displayed at higher rates by introvert participants. It should be noted, however, that these effects were present in the control interaction only, as the frequency of smiling observed in the bargaining condition appeared to be unaffected by personality variables (*Table 5.8a*).

Table 5.8b. Summary of stepwise regression analyses performed on the different types of smile displayed in the control interaction. Predictors are five major dimensions of personality: neuroticism, extroversion, openness to experience, agreeableness, and conscientiousness.. $^{*}p < .05$, $^{**}p < .01$

	F	R^2_{adj}	*Predictors*	*B*	*SE B*	*β*	*t*
Smile rate							
Non-Duchenne	7.85**	.23	Agreeableness	1.06	0.31	.47	3.41**
			Extroversion	-1.67	0.53	-.43	-3.14**
Duchenne	0.7	-.03	–	–	–	–	–
Open	5.01*	.08	Agreeableness	1.19	0.53	.31	2.24*

The impact of personality on laughter rates was evaluated using a stepwise logistic regression with the occurrence of laughter (coded 'yes' or 'no') as dependent variable, and the five personality dimensions as predictors. The results are summarized in *Table 5.9*. The probability that a voiced laugh occurred in the control and the bargaining interaction appeared to be significantly affected by personality. Overall, the accuracy of the model for voiced laughter was 71% (control) and 65% (bargaining) and could explain between 10% and 15% of the variance in the control interaction and between 8% and 11% of the variance in the bargaining interaction. The accuracy of the model for the unvoiced laughs displayed in the control condition was 77% and could explain between 10% and 15% of the variance (*Table 5.9*).

Table 5.9. Omnibus Tests of Model Coefficients for stepwise logistic regression (*Forward:LR*). Predictors are neuroticism, extroversion, openness to experience, agreeableness, and conscientiousness. Key: [a]control interaction, [b]bargaining interaction. [c]Non-significant χ^2 values were obtained with the 'enter' method. $^{*}p < .05$, $^{**}p < .01$

Criterion	*Chi square*[c]	*df*	*Cox & Snell* R^2	*Nagelkerke* R^2
Voiced laughter[a]	8.27**	1	.10	.15
Unvoiced laughter[a]	5.22*	1	.10	.15
Voiced laughter[b]	4.11*	1	.08	.11
Unvoiced laughter[b]	2.63	5	–	–

Openness to experience appeared to be the most important predictor in the model, as it positively affected the probability that an episode of vocalised laughter would occur during an interaction. Unvoiced laughter was poorly influenced by personality (*Table 5.9*). Nevertheless, extroversion had a negative impact on the probability that unvoiced laughter would occur in the control interaction, showing that introvert people were more likely to display unvoiced laughs during the waiting condition (*Table 5.10*).

Table 5.10. Regression coefficients showing the impact of personality on laughter

Criterion	*Predictors*	*B*	*SE*	*Wald* χ^2	*p*	*EXP (B)*
Voiced laugh[a]	Openness	1.39	0.68	4.19	.041	4.03
	Constant	-3.70	1.42	6.82	.009	0.02
Unvoiced laugh[a]	Extroversion	-2.16	1.14	3.60	.058	0.11
	Constant	3.20	2.25	2.02	.15	24.59
Voiced laugh[b]	Openness	1.09	0.57	3.64	.056	2.97
	Constant	-1.74	1.08	2.60	.11	0.17

3.4. Smiling, Laughter, and Altruism

The Altruism Scale (Johnson *et al.*, 1989) generally gives three scores that measure people's involvement in altruistic acts: a score for the number of altruistic acts performed, a score for the number of altruistic acts received, and a score measuring the importance of these acts for the person. In addition to these scores, the friendship questionnaire included an item measuring altruistic tendency towards the friend ('what percentage of your salary would you give up to help your friend if he/she finds

him/herself in a difficult situation?'). Because these different measures of altruism correlated with each other, an altruism index was computed by averaging the number of altruistic acts performed, the importance of those acts for the person, and the financial help that would be given to the friend. The number of altruistic acts received was not included in the altruism index because the main interest of this study was to measure the influence of the sender's altruistic dispositions on his/her own smiling and laughter.

Associations between smiling and measures of altruism were first investigated using correlation analysis. Correlations are shown in *Table 5.11a* and show positive associations between smiling and the measure of altruism. The *duration* of Duchenne smiles shown in the bargaining interaction was negatively related to the altruism index, indicating that people who scored high on altruism tended to show shorter Duchenne smiles while sharing. On the other hand, the *frequency* of these smiles was positively related to the measure of altruism. Other smile types were unrelated to altruism. However, the duration of non-Duchenne smiles displayed in the control interaction was positively related to the friend's rating of generosity after the interaction (*Table 5.11a*).

Table 5.11a. Pearson correlations between smiling, altruism index, generosity scores received from friend. $^{*}p < .05$. [c]Spearman correlations.

	Altruism Index	*Generosity*
Smile duration[a]		
Non-Duchenne	.11	.30*
Duchenne	.11	-.05
Open	.09	.05
Closed[c]	-.15	.20
Smile rate[a]		
Non-Duchenne	.04	.14
Duchenne	.12	-.18
Open	.10	-.16
Closed[c]	-.12	.19
Smile duration[b]		
Non-Duchenne	-.17	.14
Duchenne	-.31*	-.11
Open	-.20	.08
Closed[c]	-.12	.20
Smile rate[b]		
Non-Duchenne	-.22	-.19
Duchenne	.31*	.04
Open	.11	-.26
Closed[c]	.01	.23

A stepwise regression analysis was also conducted with altruism index and generosity scores received from the friend as predictors, and smiling as criterion. Results are presented in *Table 5.11b* and show that smiles displayed in the control condition were poorly affected by altruism. Nonetheless, the duration of non-Duchenne smiles was positively related to generosity scores, indicating that participants who showed longer non-Duchenne smiles during the control interaction received higher generosity ratings from their friends. Although the *durations* of most smiles shown in the bargaining interaction were not influenced by measures of altruism, these measures were significantly related to the *rate* of Duchenne smile. Participants who had high indices

of altruism also showed increased rates of Duchenne smiles (*Figure 5.6*). This relationship was not present for other types of smiles.

Table 5.11b. Summary of stepwise regression analyses performed on the different types of smile. Predictors are altruism index and generosity score received from the friend. Key: [a]control interaction, [b]bargaining interaction, [c]non-significant values were obtained using the 'enter' method. $^{*}p < .05$

Smile duration[a]	F^{c}	R^2_{adj}	*Predictors*	*B*	*SE B*	β	*t*
Non-Duchenne	4.70*	.07	generosity	0.33	0.15	.30	2.17*
Duchenne	0.37	-.03	–	–	–	–	–
Open	0.21	-.03	–	–	–	–	–
Smile rate[b]							
Non-Duchenne	1.83	.03	–	–	–	–	–
Duchenne	4.84*	.07	altruism index	0.85	0.39	.31	2.20*
Open	2.21	.05	–	–	–	–	–

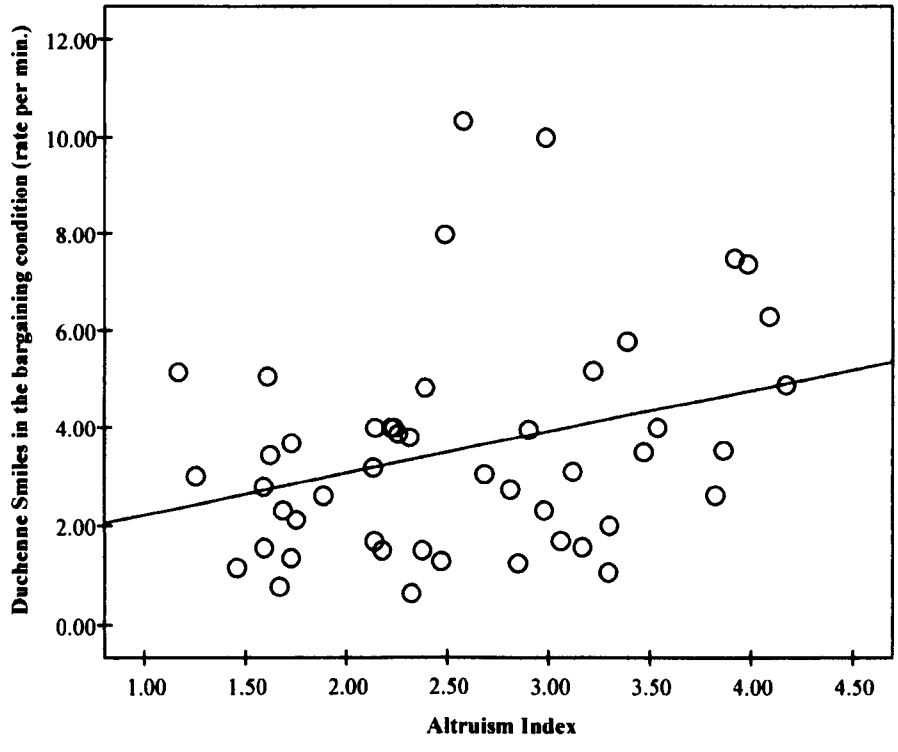


Figure 5.6 Relationship between altruism and Duchenne smile (rate per min.) displayed in the bargaining interaction.

The relationship between altruism and laughter was investigated using logistic regression, with the altruism index and generosity scores (received from friend) as

predictors, and the occurrence of laughter (coded 'yes' or 'no') as dependent variable. None of the measure of altruism affected the likelihood of observing an episode of laughter (of any type), independently of the experimental condition. These results are presented in *Table 5.12.*

Table 5.12. Omnibus Tests of Model Coefficients for Logistic Regression. Predictors are altruism index and generosity scores received from friend. Key: [a]control interaction, [b]bargaining interaction. [c]non-significant χ^2 values were obtained with the 'enter' method. $df = 2$

Type and Context	*Chi square*[c]
Voiced laughter[a]	0.78, n.s.
Unvoiced laughter[a]	1.09, n.s.
Voiced laughter[b]	0.12, n.s.
Unvoiced laughter[b]	0.84, n.s.

3.5. Smiling, Laughter, and Emotion

This section investigates the impact of self-reported emotion on smiling and laughter rates. However, before assessing the relationship between emotion and affiliative behaviours, the effect of experimental condition on emotional experience will be analysed. Note that participants reported their emotional experience on two occasions during the study: the first time was after the control interaction and the second time was after the bargaining game. In fact, the increase in Duchenne smile and voiced laughter observed between the control and the bargaining interactions (*Figures 5.2, 5.3, and 5.4*) could be explained by a difference in self-reported emotion between the two conditions. In order to assess the validity of that claim, a paired-sample *t*-test was performed with scores of self-reported emotions as dependent variables. Self-reported anger and disgust did not follow normal distributions and were therefore analysed with the Wilcoxon's Signed Rank Test. Results showed that emotional experience did not differ substantially between conditions (*Table 5.13*).

Table 5.13. Mean scores (and standard deviations) of emotional experience reported after the control and the bargaining interactions. Medians and *z* statistics are shown for anger and disgust scores.

Emotion	*Control, n=48*	*Bargaining, n=48*	*t*	*d*
happiness	6.23 (2.10)	6.50 (2.17)	-1.19	0.13
surprise	3.76 (2.78)	3.28 (2.50)	1.25	0.18
fear	1.18 (1.33)	0.96 (1.40)	1.57	0.16
sadness	1.33 (1.74)	1.02 (1.46)	1.44	0.19
relaxedness	6.06 (2.38)	6.16 (2.62)	-0.27	0.04
			z	*r*
anger	*Mdn* = 0.65	*Mdn* = 0.50	-0.48	-.05
disgust	*Mdn* = 0.25	*Mdn* = 0.22	-1.14	-.12

The second step in the analysis of self-reported emotions was to assess their possible associations with smiling and laughter. Correlations between smiling and self-reported emotional states are reported in *Table 5.14*. Smiling was poorly related to self-reported emotions, as the only significant association was a positive relationship between the frequency of non-Duchenne smiles in the bargaining interaction and sadness. This indicates that people who reported high feelings of sadness tended to show elevated rates of non-Duchenne smiles during the bargaining game.

Table 5.14. Pearson correlations between smiling and self-reported emotional states. Key: [a]control interaction, [b]bargaining interaction, [c]Spearman correlations. $^{*}p<.05$

	anger	*fear*	*sadness*	*disgust*	*happiness*	*surprise*	*calmness*
Smile duration[a]							
Non-Duchenne	.07	.13	.14	.07	-.10	-.02	-.05
Duchenne	.16	-.02	-.03	-.04	-.04	-.07	-.27
Open	.20	-.08	-.01	-.02	-.25	-.02	-.21
Closed[c]	.09	.18	.18	.14	-.17	-.20	-.22
Smile rate[a]							
Non-Duchenne	.10	.001	.23	.16	-.14	-.03	-.06
Duchenne	-.01	.20	.26	-.08	-.26	-.09	-.13
Open	.05	.01	.17	0.4	-.23	.03	-.05
Closed[c]	.03	.18	.20	.10	-.13	-.26	-.19
Smile duration[b]							
Non-Duchenne	.22	.21	.18	.03	.07	-.14	-.27
Duchenne	.04	.02	-.17	.14	.04	.02	-.26
Open	.07	.02	-.14	.14	.16	.06	-.14
Closed[c]	.02	.05	.10	.03	.04	-.07	-.07
Smile rate[b]							
Non-Duchenne	.08	.23	.30*	.12	.01	.07	.10
Duchenne	.04	-.05	.05	-.12	-.02	-.03	.15
Open	.14	.13	.20	.01	-.05	-.03	.08
Closed[c]	-.05	.05	.13	-.02	.09	.002	.09

The impact of emotions on laughter appeared to be restricted to vocalised laughs only (*Table 5.15*). Indeed, logistic regressions with the occurrence of laughter (coded 'yes' or 'no') as dependent variable and the seven emotional states as predictors, reported no association between emotions and the probability that unvoiced laughter would occur, regardless of the experimental condition. On the other hand, the likelihood of hearing voiced laughter was affected by emotional states. The models for voiced laughter could accurately predict 71% of cases in the control situation, and 65% of cases in the bargaining interaction. As shown in *Table 5.15*, these models could explain between 9% and 13% of the variance (control) and between 9% and 11% of the variance (bargaining).

The examination of regression coefficients indicates that the probability of observing voiced laughter was affected by fear in the control interaction, and by anger in the bargaining interaction. The effects of these emotional states were positive and showed that individuals who reported high levels of fear and anger were more likely to display at least one episode of vocalised laughter during the control and the bargaining interactions, respectively (*Table 5.16*).

Table 5.15. Omnibus Tests of Model Coefficients for Logistic Regression. Predictors are anger, happiness, sadness, fear, disgust, surprise, and calmness. Key: [a]control interaction, [b]bargaining interaction, [c]non-significant χ^2 values were obtained with the 'enter' method. $^{*}p < .05$

Criterion	*Chi square*[c]	*df*	*Cox & Snell* R^2	*Nagelkerke* R^2
Voiced laughter[a]	4.37*	1	.09	.13
Unvoiced laughter[a]	8.02	7	–	–
Voiced laughter[b]	4.29*	1	.09	.11
Unvoiced laughter[b]	6.22	7	–	–

Table 5.16. Regression coefficients showing the impact of emotions on laughter

Criterion	*Predictors*	*B*	*SE*	*Wald* χ^2	*p*	*EXP (B)*
Voiced laugh[a]	fear	1.28	0.63	4.10	.043	3.59
	Constant	-1.89	0.59	10.12	.001	0.15
Voiced laugh[b]	anger	1.10	0.57	3.77	.052	3.01
	Constant	-0.33	0.41	0.64	.42	0.72

Although the sender's mood had a weak effect on his/her own smiling and laughter, it is possible that these behaviours had an impact on the receiver's emotional state. Since the emotions were reported *directly after* the interactions took place, a possible effect of smiling and laughter on receiver's internal state could be detected.

A stepwise linear regression was performed with smiling rates per minute (non-Duchenne, Duchenne, open) and the occurrence of laughter (voiced and unvoiced) as predictors. The dependent variable was the friend's self-reported happiness. The analysis showed that the friend's self-reported happiness after bargaining was positively affected by open smiles displayed during that interaction, $F(1, 46) = 4.07, p$

= .049, R^2_{adj} = .06, β = .28, indicating that participants reported greater feelings of happiness when their friends had shown high rates of open smiles while bargaining (*Figure 5.7*). Interestingly, the focal's self-reported happiness remained unaffected by his/her own smiling and laughter, regardless of the condition (control: $F(5, 42) = 0.99$, $p = .43$, bargaining: $F(5, 42) = 0.44$, $p = .81$).

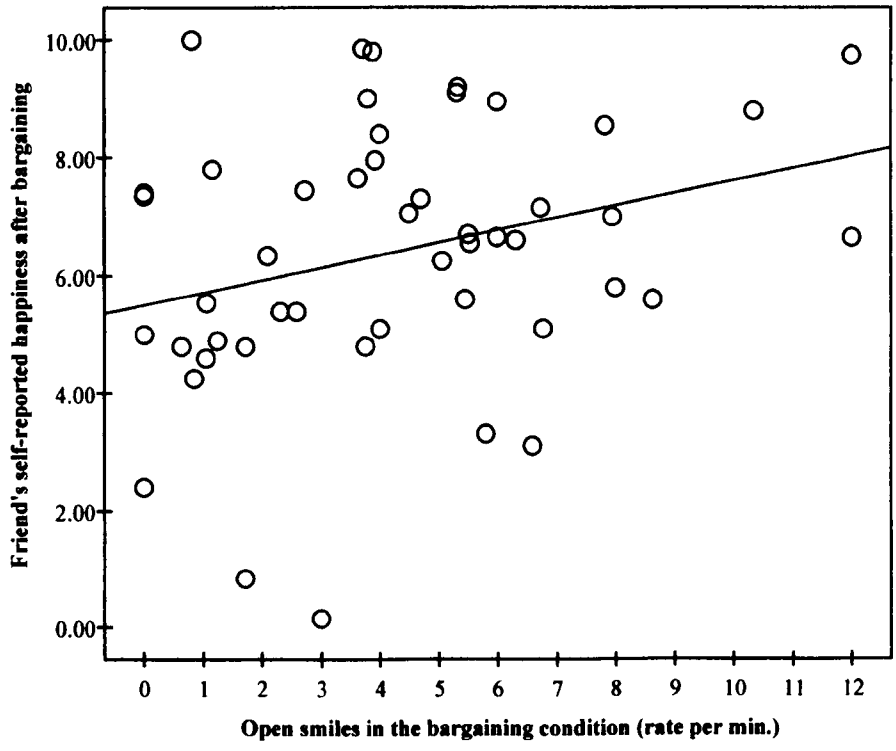


Figure 5.7. Relationship between open smiles showed by the focal during the bargaining interaction and the friend's self-reported happiness directly after the interaction.

There was also a positive and significant relationship between the occurrence of voiced laughter and the friend's feelings of calmness reported after the control interaction, $F(1, 46) = 4.3$, $p = .04$, $R^2_{adj} = .07$, $\beta = .29$. This suggests that participants felt more relaxed after an interaction during which their friend had displayed at least one episode of vocalised laughter. This effect seemed to be specific to voiced laughter, as the friend's mood was unaffected by unvoiced laughter ($\beta = -0.13$, $t = -.9$, $p = .37$) (*Figure 5.8*). The occurrence of laughter had no impact on the laugher's self-reported feelings of relaxedness (control: $F(5, 42) = 0.61$, $p = .69$; bargaining: $F(5, 42) = 0.57$, $p = .72$),

indicating that laughter had a stronger effect on the receiver's emotional state than on the sender's.

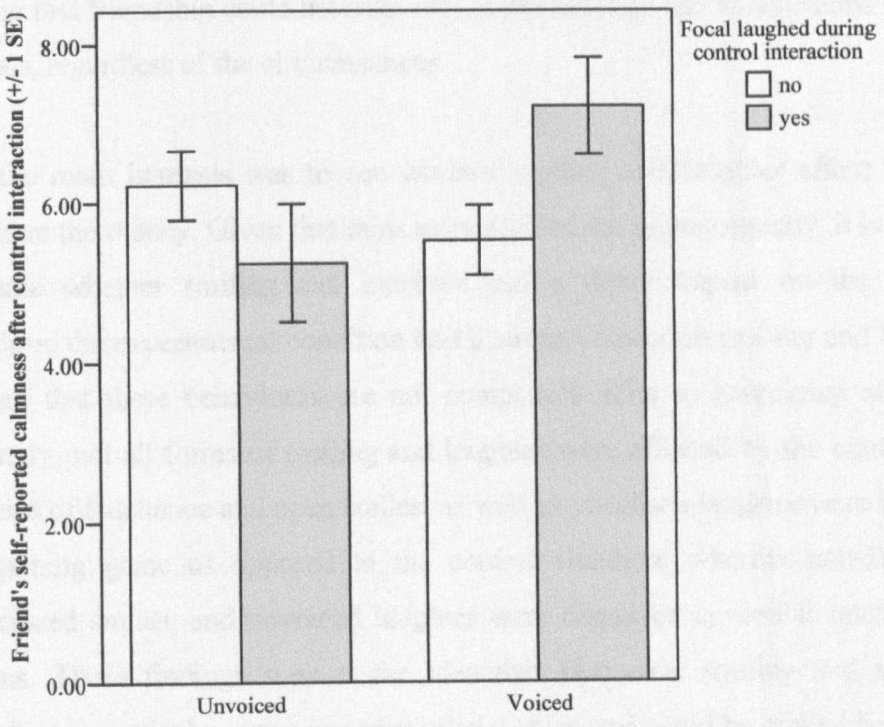


Figure 5.8. Effect of focal's laughter on the friend's self-reported feelings of calmness after the control interaction.

4. Discussion

4.1. Bargaining

Bargaining between friends resulted in much fairer outcomes than what is usually observed when strangers participate to similar experiments. Indeed, 92 percent of pairs shared the money evenly, independently of whether they played an ultimatum or a dictator game. In dictator games played anonymously within a student population, proposers generally allocate between 10 and 25 percents of the money to the recipient (Smith, 2000), whereas the average share in ultimatum games lies in the range between 30 and 50 percents (Hoffman *et al.*, 1996). The present results do not only show that

pairs of friends share more money than strangers do, but also that the outcome is independent of the modalities of bargaining. Finally, these results are the opposite of what we would expect if people behaved in accordance to the *selfishness axiom*, suggesting that friendship could have the role of maintaining fair relationships between individuals, regardless of the circumstances.

One of the main interests was to see whether smiling and laughter affect the way people share the money. Given that most pairs divided the money equally, it is difficult to evaluate whether smiling and laughter had a direct impact on the sharing. Nonetheless, the experimental condition had a strong impact on smiling and laughter, suggesting that these behaviours are not completely alien to bargaining situations. Interestingly, not all forms of smiling and laughter were affected by the context. The frequencies of Duchenne and open smiles, as well as vocalised laughter were higher in the bargaining game as opposed to the control situation, whereas non-Duchenne smiles, closed smiles, and unvoiced laughter were displayed at similar rates in both conditions. These findings support the idea that Duchenne smiling and vocalised laughter have a particular status in social relationships and could be critical behaviours in situations that involve the sharing of material resources. On the other hand, non-Duchenne smiles and unvoiced laughter seem to play a minor role in bargaining between friends.

The fact that some kinds of smiles were more relevant to bargaining than others supports the assumption that smiling functions to advertise particular dispositions. For example, smiles that involve an emotional component (e.g. the Duchenne marker) are believed to be honest signals of altruistic dispositions (Brown *et al.*, 2003) and should therefore be particularly adaptive in situations that entail cooperative aspects. This assumption was vindicated by two findings: (1) the frequency of Duchenne smile increased in bargaining contexts as opposed to control situations, and (2) people who scored high on the altruism index also showed higher rates of Duchenne smile, *in bargaining situations only*. These results show that people could use Duchenne smiles adaptively, as they displayed higher rates of that behaviour in a social context that involved the sharing of material benefits. Moreover, the positive connection between

the altruism index and Duchenne smiles displayed in the bargaining situation suggests that the function of the Duchenne smile could be linked to the advertisement of altruistic inclinations. This supports the proposal made by Brown and colleagues (2003) that the Duchenne smile could be a reliable indicator of altruistic dispositions.

The alternative explanation that people felt happier during the bargaining interaction and showed more Duchenne smiles as a result was not supported. Indeed, self-reported happiness was the same after bargaining than after the control interaction, a finding that excludes the possibility that the increase in Duchenne smiles was due to enhanced emotional experience. In addition, self-reported happiness failed to predict both the frequencies and durations of any form of smiling and laughter, regardless of the type of context in which people interacted. Therefore, these results show that the type of interaction (control vs. bargaining) and altruistic dispositions might be more important than emotion to explain smiling, and to some extent, laughter.

One should be cautious, however, when interpreting these results as evidence that the Duchenne smile is a cue to altruism. First, one could argue that the bargaining situation did not involve authentic altruistic acts, as the money was shared equally by most pairs. Hence, if Duchenne smiles do signal something, it might be a concern about fairness more than altruism *per se*. Second, the items of the 'Altruism Scale' do not all represent altruistic acts in the sociobiological sense but also include actions that carry little fitness related costs (Johnson *et al.*, 1989). Therefore, the altruism index reflects a more general inclination to help rather than genuine altruistic dispositions. A more modest way to interpret the present findings would be that the Duchenne smile serves to implement a social strategy based on helping and fairness, and that it can be used adaptively in interactions with friends.

As mentioned earlier in this chapter, bargaining does not exclusively entail aspects related to cooperation but also involves a hierarchical dimension. For some reasons mainly related to individual differences, cooperative interactions are not always balanced but often involve a little asymmetry between protagonists. In the present study, the asymmetry was formalised under two modalities of bargaining: the dictator

game (strong asymmetry), and the ultimatum game (low asymmetry). The leading position in the bargaining interaction was determined by the results to a quiz game and therefore implied an asymmetry in 'abilities' between the participants. The winner of the quiz game became the dictator (in dictator games) or the proposer (in ultimatum games), whereas the loser became the recipient.

It was proposed that individuals who had not the priority of access to the resource (recipients) would smile more in order to get a share. Therefore it was expected that subordinates (individuals who had less) would smile more than dominants (those who control the resource) and that these smiles would reflect attempts to access the resource through social means. Although people smiled equally *often* in dictator and ultimatum games, the type of game and the role played in the game interacted together to influence the *duration* of Duchenne smiles. In dictator games, Duchenne smiles displayed by recipients were on average longer than those given by dictators, whereas this difference was absent in ultimatum games. The power asymmetry between roles was therefore reflected in the pattern of smiling, as the difference in smile durations was greater when the asymmetry was large, i.e. in dictator games. In addition, Duchenne smiles shown by proposers (in ultimatum game) were significantly longer than those shown by dictators, whereas Duchenne smiles displayed by recipients were equally long regardless of the game in which they were involved. Therefore, these findings show that participants who had a greater decision power over the resource (dictators in dictator games) exhibited shorter smiles on average than those who had to obtain a part of the resource through social means.

The specificities of the bargaining situation had a weaker impact on laughter than on smiling. Although the results showed that vocalised, but not unvocalised, laughter occurred at higher rates in the bargaining condition, people laughed equally often regardless of whether they were playing dictator or ultimatum games, and independently of the roles played in those games. It seems that participants were particularly amused in the bargaining as opposed to the control interaction and this might be due to the peculiarity of the experiment or to the playful character of the situation. It is possible that participants did not take the bargaining game seriously,

knowing beforehand that they would share the money equally. Indeed, some of the participants reported after the experiment that they had already decided before coming that, in the event of a share, they would divide the money equally. Consequently, the fact that participants were friends could have influenced some of the results.

4.2. Friendship

The increase in Duchenne smiles observed in the bargaining situation might reflect the possibility that, through smiling, friends tried to emphasize the importance of their relationship and thereby determine how the money would be shared. If smiling was used to emphasize friendship, it should be related to some dimensions of friendship as measured by the questionnaire. Results show that the quality of friendship had no impact on the *frequency* at which people smiled, regardless of the situation they were in. The only association observed between smiling and friendship was a negative relationship between the *duration* of open smiles in the bargaining interaction and the judgements of the friend's qualities in terms of generosity, trustworthiness, and reliability. This suggests that people who had a poor opinion of their friend tended to show elongated open smiles while sharing. It could be that people who doubted about their friend's propensity to share might have felt the need to emphasize their positive intentions and influence the transaction through smiling. This therefore suggests that people could adjust their smiling to the perceived probability of a certain outcome. Further research is needed to address this issue.

Friendship had a different impact on laughter than on smiling. While smiling was either unaffected or negatively affected by the participant's opinion of their friend, the likelihood to observe one episode of voiced, but not unvoiced laughter, could be predicted by the friend's qualities. The more generous, trustworthy, and reliable a friend was considered, the higher the chance was of observing vocalised laughter in the control interaction, and this trend seemed to be particularly salient in men. Note that the sex of the focal also influenced the probability of observing vocalised laughs, this probability being higher with women. Although past research by Grammer and Eibl-Eibesfeldt (1990) suggested that laughter in women could be affected by interest in the

partner, such a result did not emerge from the present analysis. Nonetheless, this chapter confirms the particular status that vocalised laughter could have in social relationships (Grammer & Eibl-Eibesfeldt, 1990; Bachorowski & Owren, 2001). More precisely, vocalised laughter could be a honest signal that communicates the receiver's perception of the sender's qualities (generosity, trustworthiness, reliability). In addition, the effect of vocalised laughter on the friend's feelings of relaxedness after the control interaction suggests that the effect of voiced laughter on the receiver's emotional state might not be restricted to happiness, a connection that had already been reported in earlier studies (Bachorowski & Owren, 2001).

4.3. Personality

Personality was another factor assumed to influence smiling and laughter. In particular, connections between smiling, agreeableness and extroversion were expected because these two dimensions usually cover most aspects of social engagement (McCrae & Costa, 1989). The present data showed that the *frequencies* of open smiles and non-Duchenne smiles in the control situation were positively affected by scores of agreeableness, indicating that people who scored high on that dimension initiated a lot of those smiles. The fact that Duchenne smile *rates* were not influenced by agreeableness suggests that the activation of muscles around the eyes might not be a crucial aspect in the advertisement of that trait. On the other hand, the opening of the mouth while smiling appeared to be more relevant to agreeableness. This last point is interesting given that teeth baring is the element that was used by primatologists to make the connection between smiling and the *silent bared-teeth* display in related species (van Hooff, 1972; Preuschoft & van Hooff, 1997). In this context, it is important to remember that the *silent bared-teeth* display is present in most non-human primate species and usually has affiliative consequences (Preuschoft & van Hooff, 1997; Waller & Dunbar, 2005). If mouth opening is an evolutionary ancient feature of smiling and is seen mostly in affiliative contexts, it is not surprising to see it connected to one of the most fundamental aspects underlying prosocial behaviour, i.e. agreeableness.

Although Duchenne smile *rates* were unaffected by personality, the overall *duration* of Duchenne smiles was positively related to agreeableness. The Duchenne smiles displayed by people with high scores of agreeableness were, on average, longer. If the frequency of smiling could inform about other people's agreeableness, smiles of agreeable people tended to last longer when these smiles involved an emotional component. For people who scored high on agreeableness, muscles' activity around the eyes might have led to a stronger activation of *zygomaticus major*, and could have thereby produced longer smiles. Consequently, agreeableness could be reflected not only by frequent open smiles, but also by longer Duchenne smiles. A better knowledge of the physiology underlying facial muscles' activity is needed to understand how individual differences in behaviour can be linked to major personality traits believed to reflect evolved social strategies.

Surprisingly, extroversion showed little connection with smiling and laughter and was even negatively related to the frequency of non-Duchenne smiles displayed in the control interaction. Introverted people appeared to show more of these smiles than extroverts. Duchenne smiles and voiced laughter were not related to extroversion. Past research had shown, however, that extroverts usually show more enjoyment displays such as Duchenne smiles and laughter (Ruch, 1994). There are a couple of reasons why the present study might be at odds with past results. First, research conducted by Ruch (1994) looked at enjoyment displays in response to humour whereas the study reported here investigated naturally occurring behaviour. Hence, it is possible that extroverts are more responsive than introverts to formal and cultural stimuli like humour, but that these differences are weaker when spontaneous behaviour is recorded. Second, the range of extroversion scores observed in the present study was limited to three categories (out of five possible). In fact, many participants were not particularly extrovert (not scoring higher than three), making our sample less representative. Therefore, the connection between extroversion and smiling should be taken cautiously because the data were limited. This study should be replicated with a sample size representative of a wider range of variation on the extroversion spectrum.

Personality had a different effect on laughter than on smiling, and that effect depended on the type of laugh. Although the effects were small, vocalised laughter was influenced by openness to experience (in both types of interactions), whereas unvoiced laughter was negatively related to extroversion. The probability of observing an episode of voiced laughter was higher when people scored high on openness, indicating that voiced laughter could advertise openness to new experiences. Introverted participants, on the other hand tended, to show more unvoiced laughs. Given that these laughs are generally of lower intensities, it is not surprising that less expressive individuals are more likely to display them. Finally, the fact that smiling and laughter were affected by personality in a different way partly supports the claim that these behaviours originated in two separate motivational systems (van Hooff, 1972).

4.4. Emotion

The finding that smiling was weakly connected to self-reported emotional experience has already been discussed. The only relationship that was found was a positive effect of sadness on the frequency of non-Duchenne smile in the control interaction. People who reported stronger feelings of sadness tended to show more non-Duchenne smiles. This indirectly supports the view that smiling expresses emotion. However, according to Paul Ekman's proposal measures of Duchenne smile should be strongly connected to positive emotions such as happiness or relaxedness (Ekman, 1982). The present data showed that it is not always the case, and that social and contextual variables might have a stronger impact on Duchenne smiles than emotions.

Nonetheless, emotions were not completely unrelated to affiliative displays, as the friend's emotional state was influenced by the focal's smiling and laughter. Indeed, the friend's feeling of happiness after bargaining was positively affected by open smiles displayed by the focal during that interaction, indicating that participants reported greater happiness when their friend had shown high rates of open smiles while bargaining. Interestingly, the focal's self-reported happiness remained unaffected by his/her own smiling and laughter regardless of the type of interaction considered. If

smiling does not depend on the sender's emotional states, it could modify the receiver's positive feelings, a finding that supports claims from the field of behavioural ecology that social signals could work by modifying the receiver's internal state (Krebs & Dawkins, 1981; Owren & Bachorowski, 2003). Because the receiver's emotion was modified in a positive manner, it is likely that his/her stance towards the sender would be modified in a similar way and lead to increased rates of prosocial behaviour. In that sense, smiling could certainly be adaptive in the development of social relationships.

Overall, this chapter showed that open smiles, Duchenne smiles, and vocalised laughter should play a crucial role in situations that involve the sharing of material resources between friends. Although smiling and laughter were affected by friendship and personality, these effects were restricted to the control interaction. This suggests that when situations are not explicitly goal oriented, smiling and laughter could emphasize more general aspects of social relationships. On the other hand, Duchenne smiles displayed in the bargaining interactions were positively affected by altruistic dispositions. These results give support to the assumptions that people could adjust their facial expressions to particularities of the social situation (Fridlund, 1994) and that this adjustment could reliably reflect internal dispositions (Brown *et al.*, 2003).

Chapter Six

GENERAL DISCUSSION

The objective of the present thesis was to investigate the function of smiling and laughter. Although previous research underlined the fact that these behaviours have a social function (Bowlby, 1969; van Hooff, 1972; Grammer, 1990; Fridlund, 1991), it is still not clear whether smiling and laughter are specific to a particular type of relationship (e.g. mating, social competition, or cooperation) or if they have a more general function such as social bonding. Given the variety of smiling and laughter types, it is also possible that each type is specific to a particular context but ultimately functions to bond individuals together. Indeed, many facets of our social relationships, including mating and cooperation, entail aspects of social bonding (Dunbar, 1996a). A common method used by ethologists to gain insight about the function of a behaviour is to consider the contexts and consequences of that behaviour (Hinde, 1975; Waller & Dunbar, 2005). This approach has been used all along the present thesis and will now help summarize and make sense of the various results obtained from the different studies.

6.1. Context of Smiling and Laughter

The first observational study showed that the frequency of smiling and laughter varies with different aspects of group size and composition. Interestingly, the different types of smiles were not affected by the same factors; neither were men and women's behaviours influenced in the same ways. For example, the frequencies of spontaneous smiling and laughter displayed by men and women increased in line with party size, whereas forced smile rates in men was unaffected by the number of other people in the group. Moreover, the effect of group size on spontaneous smiles was twice as strong in women as in men. For women, the number of individuals from both sex classes influenced smiling and laughter rates (with men having a larger impact than women),

whereas for men, affiliative behaviours were affected by the number of other men but not women.

Therefore the presence of men in a group appears to be a crucial factor in the display of smiling and laughter. A field study conducted by Robert Provine (1993) had shown that both male and female audience laughed significantly more often to male than to female speakers. Although the present data did not distinguish between speaker and audience laughter, the results support those of Provine (1993) and indicate that the effect of men's presence on laughter could be linear. Furthermore it shows that this effect can be extended to spontaneous smiling, though not necessarily to forced smiling.

Another aspect of sociality relevant to smiling and laughter was the composition of groups in terms of age and sex of the individuals involved. Men, but not necessarily women, smiled more when interacting with people of their own age class. It should be noted, however, that the effect size for age composition of groups was comparable in men and women, suggesting that the absence of significance in women might have resulted from low statistical power. Interestingly, a similar effect of age composition has also been shown in the chimpanzee, a species in which the *silent bared-teeth* display has been observed mainly between individuals of the same age cohort (Waller & Dunbar, 2005). With respect to laughter, the composition of groups did not affect men and women in the same way. While men laughed more often with people of their own age than with individuals of a different age class, female laughter appeared to be more sensitive to the sex composition of groups. Women laughed at higher rates in the presence of men than when interacting with other women. These results are similar to those reported in previous studies, suggesting that the presence of opposite-sex individuals has a greater impact on female than on male laughter (Grammer & Eibel-Eibesfeldt, 1990; Smoski & Bachorowski, 2003). This leaves the door open to the possibility that laughter could be used by women as a courtship display. Unfortunately, it was impossible to determine the kind of relationship people had with their interacting partners. It is likely that the sample included a proportion of interactions between kin, which might have introduced some 'noise' in the data.

The present observations also reported that within mixed-sex groups, people's smiles were mainly directed to same-sex individuals, a finding that underlines the importance of smiling in intra-sexual relationships. This trend was further substantiated by the results of the second observational study in which men received more spontaneous smiles from other men than from women. Similarly, men were observed laughing more often with other men while women did not seem to show any preference as to which sex they laughed with. Finally, smiling and laughter rates remained unaltered by situations where intra-sexual competition for opposite-sex individuals is likely to occur, indicating that these behaviours would not principally function to regulate tense social interactions.

It is interesting to note, however, that most interactions that take place in bars or restaurants are likely to be relaxed and informal because people generally choose the persons with whom they go for a drink or food. Therefore, it is reasonable to assume that tension was fairly low in these interactions. This implies that a possible effect of tension on smiling and laughter would be hard to detect in "bar" or "restaurant" situations. Observational studies in formal settings should be more appropriate to investigate the possible impact of social tension on smiling and laughter.

Group size and composition were not the only factors to influence smiling and laughter. In fact, the age of individuals had a strong impact on female's spontaneous smiling and laughter, and young women showed more of these behaviours than mature ones. Women's age did not affect their forced smiles. In men, however, age only affected the frequency of deliberate smiles and this effect was mainly observed when men interacted in mixed-age groups. Mature men seemed to show fewer deliberate smiles than young men when interacting with people of a different age class. In addition, mature men received significantly more forced smiles than women and younger men. These results show that age has a different effect on men and women's smiling, the effect mainly depending on the type of smile considered. Furthermore, the finding that female spontaneous smiling was strongly affected by age might reflect a greater need of social network in women when conception is most likely to occur. It

would be interesting to replicate this study, taking into account women's reproductive stage and social relationships.

The importance of conversation in social situations is usually unquestioned. In addition, language is considered as one of the most significant social adaptations of our species' heritage (Dunbar, 1996a, 2004). Given the social nature of smiling and laughter, it would not be surprising to observe that conversation constitutes a major aspect of the context in which these behaviours occur. In that respect, the study presented in chapter three clearly showed that smiling and laughter are related to conversation. More precisely, talking time positively affected spontaneous smile rates, indicating that the more people were talking, the more they were giving spontaneous smiles. On the other hand, people showed high rates of deliberate smiles whilst their partner was speaking. In line with past research showing that facial expressions help regulate conversations (Lee & Beattie, 1989; Chovil, 1991; Bavelas & Chovil, 1997), the present thesis suggests that the spontaneous smile could be used to provide a certain emphasis to speech whereas the forced smile could act as a feedback that communicates attentional engagement in the conversation. Unfortunately, data did not allow a deep analysis of the relationship between smiling and conversation topics. Laughter was also facilitated by talking and listening time, especially when men were interacting together. All in all these findings support past research suggesting that laughing, smiling, and talking are strongly associated with social contexts (Provine & Fischer, 1989). The evolutionary significance of this association will be discussed at the end of this chapter.

Although the content of conversations could not be recorded, data presented in *Chapter 5* gave an idea about the particularities of the contexts that could affect smiling and laughter. Affiliative behaviours were displayed at significantly higher rates when friends were involved in the sharing of resources than when observed in a control situation. More importantly, the impact of bargaining contexts on smiling was restricted to Duchenne and open smiles. Likewise, voiced, but not unvoiced laughter was affected by bargaining contexts. The effect of the bargaining situations on smiling and laughter was independent of self-reported emotional states, suggesting that it was

the characteristics of the sharing context themselves that affected the frequencies (and duration in the case of Duchenne smiles) of affiliative behaviours. These results are at odds with earlier studies that reported connections between feelings of happiness and Duchenne smiling (Surakka & Hietanen, 1997; Ekman, 1992). Nonetheless, the present data corroborate the findings that emotional cues could also be affected by the particularities of a given social situation (Fernandez-Dols & Ruiz-Belda, 1997; Jakobs *et al.*, 1999).

The context of smiling and laughter also entails the internal state and representations experienced by the signaller. Although self-reported emotion had a poor impact on the frequencies of affiliative behaviours, personality and friendship influenced the rates and duration of smiling and to some extent laughter. For example, data revealed that people with high scores on agreeableness showed on average longer Duchenne smiles and increased rates of non-Duchenne and open smiles. Besides, people who scored high on openness to experience were more likely to display vocalised laughter. More importantly, there was a positive relationship between measures of altruism and the frequency of Duchenne smiles displayed in the bargaining interaction, indicating that the advertisement of dispositions and intentions could be specific to situations where it is potentially adaptive. Finally, the valuation of the friend's qualities (in terms of generosity, trustworthiness, and reliability) positively influenced voiced laughs, indicating that laughter could also communicate the social image that the sender has of the receiver.

6.2. Consequences of Smiling and Laughter

If a behaviour appears to have beneficial consequences for the individual performing it, that behaviour's function must therefore be associated with these consequences (Hinde, 1975). Literature informed us that the consequences usually associated with smiling and laughter are of a social nature (Eibl-Eibesfeldt, 1989; Weisfeld, 1990) and should therefore be found in the interaction process. In order to be functional, smiling and laughter should result in a chain of constant consequences which ultimately improve the social relationships that are crucial to the individual's reproductive

success. Unfortunately the present thesis was not able to trace the entire chain of consequences going from smiling and laughter to increased reproductive success. It is evident to anyone that smiling or laughing one day does not bring thousands of babies the next day. Nonetheless, a small set of potentially adaptive consequences emerged from the few studies presented here.

The acquisition of social knowledge is a crucial component of interpersonal communication and is believed to be operated through automatic processes (Bargh, 1989). Because the best source of social information lies in the actions and deeds of other group members, the first consequence of social behaviour could be to influence the perception that the receiver has of the sender. Smiling has been shown to be a good candidate to alter people's social image (Otta *et al.*, 1996; Reis *et al.*, 1990) and it has been found here to modify the assessment of evolutionarily relevant attributes in strangers (see *Chapter 4*). Moreover, the Duchenne smile had an impact on the judgement of generosity and extroversion, indicating that it could function in a more specific range of conditions, including cooperation and sharing.

An important finding was that the effect of smiling on the ratings of personal attributes depended on the sex composition of the sender-receiver dyad. Men and women's judgements were not affected by smiling in the same way, and this suggests the operation of different selection pressures associated with sex-specific strategies for social interactions. Overall, men were influenced by smiling in a larger extent than women, a finding that could reflect a higher selectivity in women's attributions. This greater selectivity in women was interpreted as being the product of strong selection pressures acting on females to avoid making social choices on the basis of a single behavioural cue. Indeed, the consequences of making risky social alliances might be higher for women than for men (Grammer, 1989) and these choices could therefore be more adaptive if they are based on more social information.

Although men were less discriminative than women, they appeared to be more selective in the attribution of generosity to other men. Indeed, generosity scores given within all-male dyads were strongly affected by the type of smile, suggesting that

positive judgements of generosity in other men required the presence of an emotional cue in the face of the sender. Such a discriminating mechanism might have evolved as a result of (1) the potential reproductive advantages of associating with generous individuals, and (2) the costs of investing in a coalition that might not ultimately pay off. It would be interesting to see whether such discriminative mechanisms are prevalent in individuals who have an altruistic strategy, as higher pay-offs should be expected when altruists form coalitions together (Roberts, 1998). This should be the topic of future research.

With regards to laughter's consequences, an interesting finding was that female's high intensity laughs significantly increased talking time in their partner, especially when the latter was a man. A similar relationship between laughter and conversation had already been found in a field study conducted by Feroud Seepersand at the University of Liverpool. His study showed that pairs continued talking about a given topic for a longer period after one of them had laughed than if neither had laughed (Seepersand, 1999). The present data and Seepersand's study both support the idea that laughter could act as a reinforcer and make the speaker continue the interaction with a given partner (Dunbar, 1996a). Moreover, the assumption that women use laughter as a probe to obtain further information about a social partner (Grammer, 1990) is also supported.

The consequences of laughter were not limited to conversational aspects but also involved a modification of the partner's self-reported emotional state. Indeed, results of the bargaining experiment showed that feelings of relaxedness were significantly higher when the friend had experienced an episode of laughter in a previous interaction than when he/she had not. More importantly, this effect was restricted to vocalised laughter, as there seemed to be no effect of unvoiced laughs on the friend's self-reported emotional state. Besides, open smiling also had an effect on the partner's internal state. Even though happiness felt by the sender was unrelated to his/her own smiling, the latter positively influenced self-reported feelings of happiness in the partner. This indicates that certain forms of smiling and laughter might have physiological effects on the receiver (assuming, of course, that self-reported emotional

states are influenced by physiological condition). Furthermore, this supports the proposal that non-verbal vocalisations could function to alter receivers' affective states (Owren & Bachorowski, 2003). The modification of emotional states could, in turn, have important consequences on the interaction process, as it has been proposed that the activation of the social engagement system in mammals depends on physiological state (Porges, 2005).

Physical proximity is at the core of social bonding among many mammals, and there is little reason to expect that it should be different for humans. The relevance of spatial relationships to bonding culminates with physical contact, a cue that the attraction process overcame the natural inclination of individuals to defend their own personal space. Of course, before engaging in such an intimate adventure people have to make sure that the other's dispositions are of an affiliative nature. Therefore, one should expect body contacts to occur when individuals have gained sufficient information about their partner so to proceed to a crucial step on the path towards a secure relationship. The present study showed that in dyadic interactions, open smiles and laughter increased the likelihood of observing body contacts between the partners. Because physical contact could be a particularly sensitive indicator of social bonding (Carter *et al.*, 1995) the present data suggest that affiliative behaviours sent at a distance could facilitate the process of relationship building.

Analysis of the contexts and consequences of smiling and laughter showed that various aspects of sociality affect different properties of these behaviours. The observation that frequency, type and duration of smiling and laughter are affected by different characteristics substantiates the proposal that these are complex signals capable of dealing with multi-level communication (Grammer *et al.*, 1997), a property that could be highly adaptive in increasingly complex social environments. Because sociality is likely to be a major player in the evolution of primate brains (Dunbar, 1993b), such an elaboration in signalling ability is most probably the product of our species' evolutionary history.

6.3. Function of Smiling and Laughter

From the analysis of context and consequences, it is tempting to conclude that smiling and laughter are involved in the formation of cooperative relationships (see also chapter two). Ironically enough, none of the studies presented herein really investigated the role of smiling and laughter in strictly cooperative contexts, i.e. in situations where people have to devote time and effort to achieve mutual benefits through a coordinated action. Nonetheless, it is known from past studies that people form relationships with non-relatives and although these long term alliances are rarely based on Tit for Tat reciprocity, they are expected to be supportive both in an emotional and a material way (Silk, 2003). Therefore a more reasonable conclusion would be that smiling and laughter are not cooperative behaviours per se, but decisive signals involved in the development of relationships that could turn out to be cooperative.

Evolutionary theory emphasized the importance of considering the balance between costs and benefits in the analysis of social behaviour (Hamilton, 1964; Trivers, 1985) and social strategies (Grafen, 1990). An important aspect of such an approach is that individual differences in a population determine the potential risks or benefits associated with a particular social relationship. In other words, everyone has not the same 'value' as a social partner. This view was further developed in the theory of 'Biological Markets' (Noë & Hammerstein, 1995) and implies that people compete with each other for access to the allies that offer the 'best value' in the 'market place' that constitutes a given population or social group. The competition for coalition partners therefore entails that people advertise their own value and thereby attract social attention, or potential investment. Because social behaviour is directly available for observation by conspecifics, it is certainly a good candidate for self-advertisement.

Data presented in the previous chapters suggest that smiling could function in the advertisement of individual traits and that this aspect could be particularly adaptive for women. Indeed smiling significantly changed the judgements made by other people on one's face. For example, women were seen as more attractive and trustworthier when

smiling than when showing a neutral face, indicating that smiling could increase the probability of women being approached by other people and eventually chosen as social partners. In addition, smiling was displayed at higher frequencies in larger groups, i.e. in the presence of more potential coalition partners. More importantly, the number of men had a strong impact on women's smiling, a finding that, when combined with the observation that the effect of female smiling on men's judgements was generalised to most dimensions under study, suggests that women could use smiling for self-presentation purposes.

If smiling is involved in the advertisement of traits that are relevant to coalition formation, the traits conveyed by smiling should be relevant to social bonding. Among the attributes investigated in the chapter on smile perception (chapter four), extroversion and agreeableness were the dimensions that were the most affected by smiling. In addition, the effect seemed to be relatively independent of the sex composition of dyads. Interestingly, these two personality attributes cover most aspects of social relatedness (McCrae & Costa, 1989). It was therefore suggested that smiling could advertise the behavioural style underlined by these two dimensions. Although extroversion is as much related to fitness costs as to benefits (Nettle, 2005), the evolutionary significance of agreeableness as an adaptive personality trait might be related to the formation of alliances and cooperative relationships (Graziano & Eisenberg, 1990; Ashton *et al.*, 1998). Therefore a personality characterised by a combination of high extroversion and agreeableness could reflect a prosocial strategy based on cooperation.

Some might wonder why smiling in particular (and not, for example, eyebrow raise) should be relevant to social bonding. The answer to that question could be found in the homology between smiling and the non-human primate *silent bared-teeth* display *(SBT)*. Comparative evidence suggests that the *SBT* evolved from a reflex-like protective behaviour into a signal of non-hostile intentions (van Hooff, 1972; Preuschoft, 1992; Fridlund, 1994). This signal then came to be used as a submissive gesture displayed by low-ranking individuals in agonistic interactions, mainly to avoid conflicts with dominants (Preuschoft, 1992). In despotic species such as the rhesus

macaque, the *SBT* can be used as a formal indicator of social status (de Waal & Luttrell, 1985). It followed that the formalisation of social dominance and its association to friendly (i.e. non-aggressive) coexistence constituted the proximal mechanisms for the integration of interpersonal affiliation and dominance relationships (de Waal, 1986). This implies that former signals of submission emancipated into friendly and reassuring gestures, as they became increasingly used in affiliative contexts by both dominant and subordinate individuals (van Hooff & Preuschoft, 2003; Waller & Dunbar, 2005). The development of such social relationships paralleled the transition from a coercive to a cooperative exploitation of resources, a transition that further facilitated the evolution of social bonding.

Therefore, one of the main reasons why a signal of non-hostile intent would have evolved into a behaviour essential to bonding is simply that it might be extremely maladaptive to form social bonds with aggressive individuals. One might argue that having an aggressive person as friend rather than enemy would be less risky. However coalitions are not devoid of quarrels, and conflicts with aggressive people might lead to devastating consequences, including death (Daly & Wilson, 1988). Consequently, the choice of coalition partners have been the object of a strong selection pressure, namely, the presence of aggressive individuals in the population.

This should have, in turn, favoured the evolution of selective mechanisms involved in the perception of non-violent dispositions in other group members. Although the presence of an emotional (hence difficult to fake) component in the smile had little impact on ratings of agreeableness, further analyses indicated that, within male dyads, the increase in agreeableness ratings due to smiling was positively related to the intensity of cheek raise, i.e. the Duchenne marker (see *Appendix two*). Note that the perception of neuroticism in male faces was also affected by the Duchenne marker. The reason why emotional cues might be more relevant to the assessment of agreeableness and neuroticism in dyads involving males might come from the need for an accurate estimation of men's aggressive tendencies. Indeed, research in personality psychology showed that the broad factor underlying agreeableness and neuroticism could represent the basic dimension of dominance-related aggressive behaviour in

humans (Archer, 1988; Zuckerman *et al.*, 1988; Caprara *et al.*, 1994). Moreover Budaev (1999) showed that this factor was more variable in men than in women, suggesting frequency-dependent selection, hence the presence in the male population of various strategies regarding the management of aggressive behaviour. If agreeableness and neuroticism are traits related to aggression and if men do vary more in that respect, it is sensible to imagine that detection mechanisms became more selective with the judgement of male faces. This might explain why judgements of neuroticism and agreeableness in men was more sensitive to an emotional cue, i.e. a facial movement difficult to produce deliberately.

The link between smiling and cooperative social strategies is further supported by research investigating the relationship between testosterone and smiling. For example, a study found that smiles of high testosterone men showed less eye crinkling (Duchenne marker) and less movements of the lip corners than smiles of low testosterone men (Dabbs, 1997). Another study showed a negative relationship between testosterone levels and time spent smiling in women (Cashdan, 1995). If testosterone might not directly influence smiling (Dabbs, 1997), it is known that concentrations of androgens in the body could mediate antisocial behaviour (Dabbs & Morris, 1990; Aromaki *et al.*, 1999), and to some extent aggression (Archer, 2006). In addition, men who are engaged in benevolent occupations tend to have lower concentrations of testosterone than men who have more competitive careers such as football players (Dabbs *et al.*, 1990). Similarly, psychological dispositions needed for the maintenance of stable family environments seem to be negatively related to testosterone levels (Julian & McKenry, 1989). The negative connection between smiling and testosterone therefore supports the assumption that smiling could advertise a behavioural style based on prosocial relationships and cooperation.

The question of whether smiling is a honest indicator of underlying dispositions was also approached. It appeared that the frequencies of non-Duchenne and open smiles and the duration of Duchenne smiles shown in dyadic interactions between friends were related to the sender's agreeableness. Furthermore, the rate of Duchenne smiling displayed in a situation involving the sharing of money was positively related to

altruistic dispositions. All in all, this indicates that if smiling is used in the advertisement of traits relevant to prosocial and altruistic behaviours, it could do so in a reliable way.

It would be unfair to conclude an evolutionary based study on social behaviour without mentioning sex differences. Although smiling had different impacts on men and women's judgements of faces, there was no sex difference in the *display* of smiling and laughter. In the three studies presented herein and that involved the observation of behaviour, men and women seemed to smile and laugh equally often. This result is to be expected assuming that men and women could both benefit from forming coalitions. However, it does not fit in the large consensus that women smile more than men (Hall, 1984; Hall & Halberstadt, 1986; LaFrance *et al.*, 2003). It was discussed earlier that this could be due to the fact that meta analyses included a large proportion of studies conducted in experimental settings and could therefore be tainted with social desirability effects. The subjects included in the present thesis did not know that their behaviour was under study. Interestingly, LaFrance and colleagues (2003) reported that observation awareness was a significant moderator of the sex difference in smiling, indicating that the extent to which women smiled more than men was affected by the knowledge of being observed. This supports the claim that women are particularly sensitive to audience effects and that they could adjust their smiling for self-presentation purposes (DePaulo, 1992). Furthermore, cultural differences also influenced the magnitude of the sex difference and this difference was minimal in the British samples included in the last meta analysis (LaFrance *et al.*, 2003). Consequently, observation unawareness and cultural specificity[8] might explain the absence of sex difference in the present data.

Future research on smiling, laughter, and non-verbal behaviour in general should concentrate on the interaction between social motives, personality, and emotion. Integrating these aspects into observational and experimental research is very much needed if we want to understand the complexity of human relationships and behaviour.

[8] Note that using cultural specificity to explain the absence of sex difference only applies to samples in chapters two and three.

Future projects should look at the personality of receivers and its influence on the perception of social cues. Indeed, some of the variation we observed in judgements of smiling faces could have resulted from variation in receiver's social strategies. The social and emotional context in which behaviour is studied should also be specified in the future. In that respect, the bargaining experiment should be replicated with pairs of friends and strangers to assess the impact of friendship on smiling and laughter. Finally, observational studies should be conducted in a larger variety of social environments, including both formal and informal settings. Such studies should, ideally, involve several investigators in order to increase the range of data that is collected (behaviour, background variables, etc).

The last words will be for the role of non-verbal behaviour in conversations. Recent developments in behavioural sciences suggest that language would function to regulate increasingly complex social groups (Dunbar, 1993b). In support of that hypothesis, it has been found that a large proportion of conversational exchanges (over two thirds) includes social topics (Dunbar *et al.*, 1997). Of particular importance is that language could buffer the facilitating role of large groups on free-riding, because people would exchange information about individuals who tend not to respect the obligations inherent to social contracts (Enquist & Leimar, 1993). In addition, language could have a crucial importance in reputation management and allow people to advertise their own qualities (Emler, 1994). More generally, language would mainly function to strengthen social bonds within large groups through a better circulation of social knowledge (Dunbar, 1996a; Barrett *et al.*, 2002).

This proposal, however, did not come without problem. Indeed, critics of the social bonding theory of language claimed that language could have never replaced grooming as a bonding mechanism because words are relatively cheap to produce in comparison to the time and effort put into grooming a social partner (Knight, 1999; Mithen, 2005). Notwithstanding the value of this claim, it forgets that the costs of language might not lie in the content of language itself, but in the way it is performed. In fact, much of what is said in a conversation is given meaning by the non-verbal cues that usually accompany utterances (Lee & Beattie, 1998; McNeill, 1992). More importantly, there

is evidence that the detection of lies greatly benefits from an analysis of non-verbal cues (DePaulo *et al.*, 1985; Ekman *et al.*, 1988). If the proposal that the 'hard-wired' connection between emotion and non-verbal behaviour authenticate social signals (Frank, 1988; Brown *et al.*, 2003), any emotionally driven cue associated with a speech episode should have the power of making utterances more reliable. This implies that language could also have evolved to extend the range of a communication system mainly based on emotional expression. Non-verbal communication should therefore be a major area in the avenue of research opened by an evolutionary approach to language.

Appendix One

RELATIONSHIP BETWEEN SMILING AND LAUGHTER IN HUMANS: TESTING THE POWER ASYMMETRY HYPOTHESIS

Paper presented at the 17th Biennial Congress of the International Society for Human Ethology, Gent, Belgium, July 2004

1. Introduction

Comparative evidence on various species of primate showed that the *silent bared-teeth* and the *relaxed open-mouth* displays – which are assumed to be homologous to human smiling and laughter (van Hooff, 1972) – do occur in a wide range of social contexts, including submission, appeasement, reconciliation, affiliation, and play (Preuschoft & van Hooff, 1997). The *silent bared-teeth* display is often shown by subordinate individuals in tensed social situations, and marks a transition to a more affiliative interaction (Preuschoft, 1995). On the other hand, the *relaxed open-mouth* or 'play face' seems to be restricted to social play and informs the partner that the behaviours it parallels are playful and not dangerous (Bateson, 1969; van Hooff, 1972).

In some species these two displays occur in rather distinct contexts (*Macaca fascicularis*: Angst, 1975; Preuschoft, Gevers, & van Hooff, 1995; *M. mulatta*: de Waal & Luttrell, 1985; Symons, 1978) whereas in others there is considerable overlap across contexts between the *silent bared-teeth* and the *relaxed open-mouth* displays (*Macaca sylvanus*: Preuschoft, 1992; *M. Tonkeana*: Preuschoft, 1995; Thierry *et al.*, 1989; *Pan troglodytes*: van Hooff, 1972; *Homo sapiens*: Blurton Jones, 1972; Lockard *et al.*, 1977; Kraut & Johnston, 1980; Goldenthal *et al.*, 1981; Fridlund, 1991), suggesting a possible convergence of these signals during the course of evolution. Furthermore, this convergence is not only reflected in the contexts of occurrence but is also evident morphologically, as indicated by the presence of an *open-mouth bared-*

teeth display in some macaques species, some apes, and in humans (Preuschoft & van Hooff, 1997).

The contextual variation of the *silent bared-teeth* and *relaxed-open mouth* displays does not follow phylogenetic boundaries, leading Preuschoft & van Hooff (1997) to suggest that the observed similarities result from analogous development, that is, the same motivational emancipation would have occurred independently in different species as a response to similar selective pressures. Because the social environment is likely to be the major selective force driving the evolution of primate brains and communication abilities (Humphreys, 1976; Byrne & Whiten, 1988a; Barton & Dunbar, 1997; Dunbar, 1998), contextual variation in social displays could be attributed to varying characteristics of social organisation. This claim has been formalised under the power asymmetry hypothesis (Preuschoft & van Hooff, 1997).

The power asymmetry hypothesis assumes that the type of social organisation shapes the meaning of displays. Under conditions of hierarchical and strongly asymmetrical relationships between individuals there will be distinct signals communicating submission and appeasement, affiliation, and playfulness; whereas in egalitarian relationships the same displays will be used to communicate submission, affiliation, appeasement and play (Preuschoft and van Hooff, 1997; van Hooff & Preuschoft, 2003). In humans, these different types of social organisation could be reflected in smaller group interactions whose composition in term of social status could influence the pattern of distribution of affiliative displays reflected by the degree of overlap between smiling and laughter. The objective of the present paper is to address that claim.

It is argued that the age composition of groups should be a good indicator of formal hierarchical relationships, at least in the environment where the present observations have been conducted. This follows the fact that different age categories have differential control over resources. The young adult category included in the study consists of individuals between 20 and 35 years old, among which a large proportion of students. A great part of these people have probably limited resources (i.e. no

salary). On the other hand, middle-aged adults (35 to 65 years old) have probably more resources at their disposal as a result of a longer and presumably more stable work career. Therefore, mature adults often enjoy higher social status than younger ones. It is proposed that the power asymmetry is larger in groups including individuals whose social status greatly differs, as a result of being at different life stage. Therefore mixed-age groups will be considered to be hierarchically asymmetrical whereas same-age groups will be deemed as being symmetrical in terms of status. It is not assumed that all young individuals are subordinate nor that all mature adults are dominant, but the distinction relies on the concept of relative dominance, i.e. the status of an individual depends on the social context of the interaction: the presence of people from a different age class will determine the status of a person according to his/her age. It is therefore suggested that mature adults tend to be more dominant in a group including young adults whereas young adults tend to be more subordinate when interacting with mature adults.

The power asymmetry hypothesis predicts that the relationship between smiling and laughter should be more distinct in contexts where formal and hierarchical relationships prevail, as opposed to contexts where status relationships between individuals are more symmetric. Therefore, a higher proportion of smiles in relation to laughter is expected when individuals interact in mixed-age groups, as people's attempts to acknowledge hierarchical distance will be disproportionate in comparison to their attempts to affiliate. On the other hand, the proportion of smiles to laughter should be more balanced in same-age groups, where hierarchical aspects are subdued to affiliation.

2. Method

192 humans ranging from 20 to 65 years old were covertly observed from a distance of 5 to 20m in two types of environments: bars and food courts. The distinction was made between two broad age categories: young adults, 20 to 35 years old; and mature adults,

35 to 65 years old. Individuals were selected if their face was accessible to the observer and if they were interacting in a stable social group.

Data were collected from June to November 2003 over a seven day week. All occurrences of smiling and laughter were sampled during focal observations performed on one individual at a time (Altmann, 1974). Duration of the samples varied from 15 to 30 minutes, according to the time that individuals spent in the place. The average duration of a sample was 22.7 min (*SD* = 5.93). Data collection covered a total of 80.36 hours of observation.

Smiles were categorised in two types: spontaneous and forced. Spontaneous smiles (also called Duchenne smiles) invovles the activity of another facial muscle called *orbicularis oculi* which raises the cheeks, gathers skin around the eyes, and narrows eye aperture (Ekman & Friesen, 1982). The forced smile category included all smiles upon which an obvious voluntary control was imposed. Moreover, the timing of the expression often indicated whether the smile was forced or not. In case of forced smiles, the expression appeared and disappeared from the face more quickly. Asymmetric smiles were also considered as being forced.

Laughter is characterised by stereotypical features including staccato breath, vocalisation, open-mouth, and body movements (mainly head, shoulders and trunk) (Grammer & Eibl-Eibesfeldt, 1990; Provine & Young, 1991). Each sequence of vocalisation was considered as an episode of laughter. A new episode was recorded if the person started a new sequence after taking breath.

The independent variables included individuals' age and sex, group size, as well as the age and sex composition of the group. The relationship between smiling and laughter was reflected by two indices (one for each smile type): the "spontaneous smile to laughter index" (SSLI) and the "forced smile to laughter index" (FSLI). These indices are simply the number of smiles divided by the number of laughs observed. High indices represent a large amount of smiles in comparison to laughter whereas low

indices correspond to a greater proportion of laughter episodes in comparison to smiles. Indices close to 1 reflect a balance between smiling and laughter.

3. Results

As stated earlier, a distinction was made between two broad age categories: young adults, 20 to 35 years old; and mature adults, 35 to 65 years old. The age composition was considered as 'mixed' when at least one person in the group was from a different age class as the focal individual. A 2 × 2 × 2 × 2 univariate analysis of variance with sex and age of focal, and sex and age composition of groups as between-subject factors was performed separately on each index (spontaneous smile to laughter, and forced smile to laughter). There was no main effect of age composition of groups on indices of smiling to laughter [SSLI: $F(1, 176) = 0.12$, $p = .91$; FSLI: $F(1, 176) = 0.14$, $p = .70$].

However, univariate analysis of variance yielded a marginally significant 3-way interaction between individuals' sex, individuals' age, and age composition of groups on FSLI, $F(1, 176) = 3.53$, $p = .06$. An analysis performed within the young men category reported a significant effect of age composition of groups on FSLI, $F(1, 40) = 4.49$, $p = .04$, but not on SSLI, $F(1, 40) = 0.77$, $p = .38$. As shown in *Figure A1.1*, young men displayed a higher proportion of forced smiles in comparison laughter when interacting in mixed-age groups than when interacting in same-age groups. There was no effect of age composition of groups within the mature men category [FSLI: $F(1, 52) = 2.1$, $p = .15$; SSLI: $F(1, 52) = 0.11$, $p = .74$] nor was there any significant effect of age within males observed in same-age groups [FSLI: $F(1, 76) = 1.26$, $p = .26$; SSLI: $F(1, 76) = 0.23$, $p = .63$]. In men, the age difference observed in mixed-age groups was only marginally significant for FSLI, $F(1, 16) = 3.77$, $p = .07$, but non significant for SSLI, $F(1, 16) = 1.2$, $p = .29$.

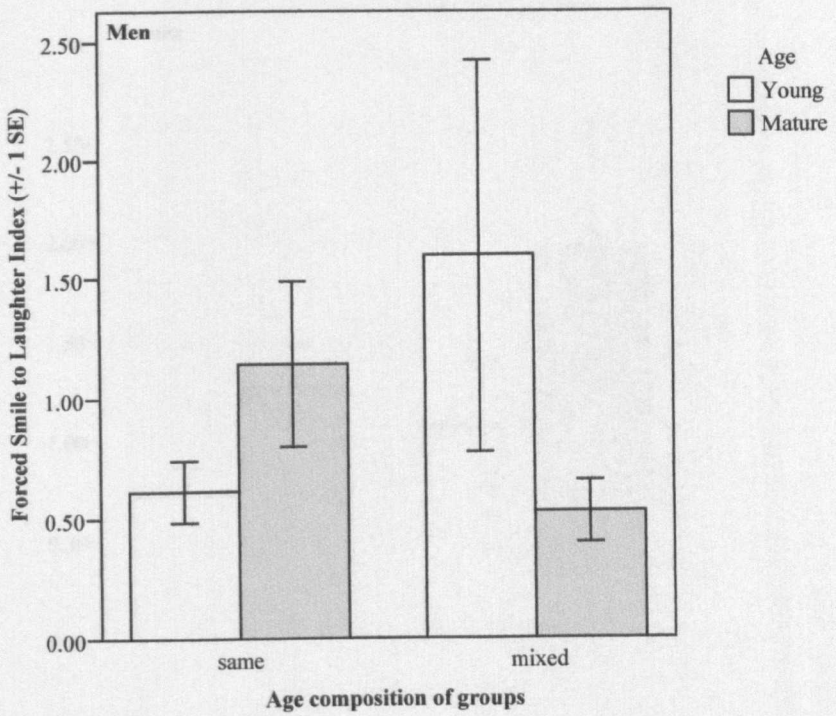


Figure A1.1 Proportion of forced smiles to laughter (mean rate per min.) in relation to age (young: <35 years old, mature: >35 years old) and age composition of groups in **men**. The index was computed by dividing rates of forced smiles by rates of laughter.

Results showed that the pattern observed in women was different than in men (*Figure A1.2*). Indeed, there was a main effect of age on women's FSLI, $F(1, 84) = 3.73$, $p = .05$, suggesting that mature women displayed significantly higher proportions of forced smile to laughter than young women. There was no effect of age on SSLI in women, $F(1, 84) = 1.37$, $p = .24$. Similarly the age composition of groups had no effect on women's FSLI, $F(1, 84) = 0.1$, $p = .75$, nor SSLI, $F(1, 84) = 0.35$, $p = .55$.

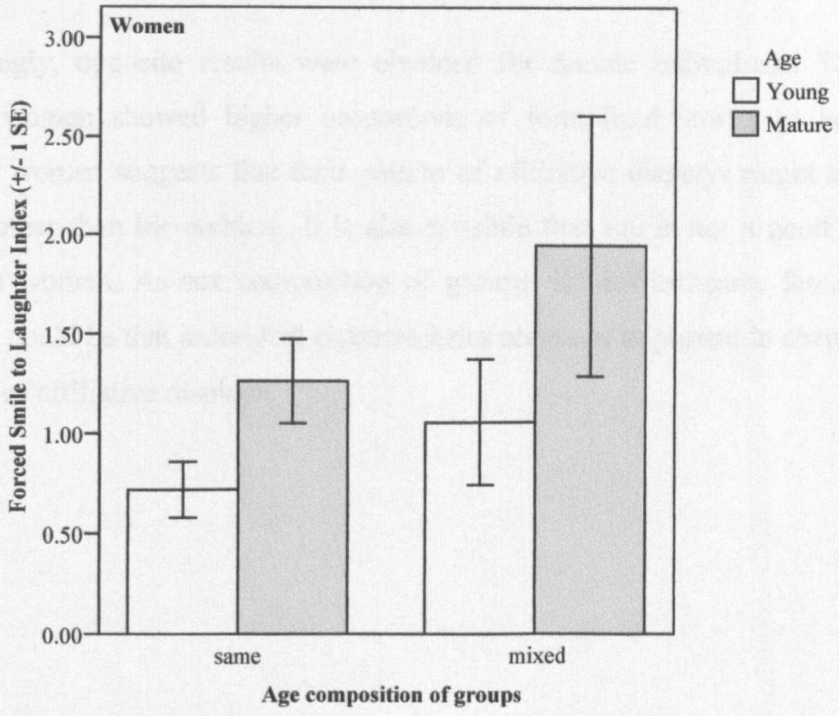


Figure A1.2 Proportion of forced smiles to laughter (mean rate per min.) in relation to age (young: <35 years old, mature: >35 years old) and age composition of groups in **women**. The index was computed by dividing rates of forced smiles by rates of laughter.

The sex composition of group had no effect on either indices of smiling to laughter [SSLI: $F(1, 176) = 0.07, p = .79$; FSLI: $F(1, 176) = 0.11, p = .74$].

4. Discussion

The results bring some support to the power asymmetry hypothesis, as young men' patterns of affiliative displays were strongly biased towards formal appeasement signals when observed in groups including individuals more dominant than themselves. This was not the case for mature adult men who seemed to make use of both signals in similar proportions independently of the social context. This result indicates that in men, voluntary attempts at formal appeasement signals are displayed by subordinate disproportionately more than playful signals when hierarchical aspects are emphasized. As opposed to spontaneous smiles, forced smiles could therefore be a distinct signal for formal appeasement.

Surprisingly, opposite results were obtained for female individuals. The fact that mature women showed higher proportions of formalized smiles to laughter than younger women suggests that their pattern of affiliative displays might be driven by factors other than hierarchical. It is also possible that age is not a good indicator of status in women. As sex composition of groups did not influence females' indices either, it could be that individual characteristics are more important in shaping women' patterns of affiliative displays.

Appendix Two

IMPACT OF INDIVIDUAL FACIAL MOVEMENTS ON SOCIAL JUDGEMENTS (EXTENSION TO CHAPTER FOUR)

A componential approach to facial behaviour implies that the action of individual facial movements carries potential meaning in overall patterns of facial expressions (Smith & Scott, 1997). The fact that the Duchenne smile had an effect on the perception of social traits (see chapter four) also suggests that individual components could influence the perception of personal attributes in faces. It is therefore possible that the impact of smiling on social judgements was affected by individual facial action units.

The intensities of four facial action units were coded from '1' to '5' using the most recent version of the Facial Action Coding System (Ekman *et al.*, 2002). These action units were: cheek raiser (AU 6), lid tightener (AU 7), lip corner puller (AU 12), and lip parting (AU 25). The degree of change between neutral and smiling conditions was chosen as an indicator of the effect of smiling and was calculated by subtracting scores obtained with neutral faces from scores obtained with smiling faces (see chapter four). Because action unit intensities represent changes in facial movements from a neutral position, it was more reasonable to relate it to a change in perception rather than to a plain score (e.g. the ratings of smiling faces). Moreover, subtracting scores obtained for the neutral face to scores obtained for the smiling face allowed a better control for the variability induced by individual differences.

Linear regression analyses were performed taking the degree of change in perception between the two conditions as criterion variable, and the intensities of facial action units as predictors. The ten individual dimensions were attractiveness, generosity, trustworthiness, competitiveness, health, agreeableness, conscientiousness, extroversion, neuroticism, and openness to experience. These dimensions were

examined separately. Due to the effect of sex on ratings (see chapter four), regression analyses were conducted taking into account the sex of judges and the sex of faces.

Results showed that attractiveness and conscientiousness were the only dimensions for which the impact of smiling was not affected by the intensity of individual facial actions (*Table A2.1*). The degree of mouth opening did not affect attractiveness ratings either, $F(3, 46) = 0.49$, $p = .69$. On the other hand, the intensities of facial actions had a substantial impact on the amount of change between neutral and smiling for the ratings of generosity, trustworthiness, agreeableness, and extroversion.

Results also revealed that the effect of facial action's intensity did not influence male and female judges in the same way, depending on the dimensions rated. For example the amounts of change between neutral and smiling in ratings made by female judges on competitiveness, health, and openness to experience were significantly affected by the intensity of facial actions intensity whereas it was not the case for male judges. On the other hand, the degree of change for neuroticism ratings observed in male judges – but not in females – was significantly related to the intensity of facial actions (*Table A2.1*).

Table A2.1. Effect of facial movement intensity on the degree of change in ratings between neutral and smiling faces. Facial action units are AU 6, AU 7, AU 12, and AU25. $^{*}p<.05$, $^{**}p<.01$

Attributes	*Male judges, n=29*		*Female judges, n=29*	
	$F(4, 45)$	R^2_{adj}	$F(4, 45)$	R^2_{adj}
Attractiveness	0.58	-.03	1.27	.02
Generosity	5.02**	.25	9.39**	.41
Trustworthiness	3.27*	.16	2.60*	.11
Competitiveness	2.37	.10	4.24**	.21
Health	0.70	-.02	6.70**	.32
Agreeableness	3.17*	.15	4.53**	.22
Conscientiousness	0.90	-.01	1.35	.03
Extroversion	12.09**	.47	12.84**	.49
Neuroticism	3.51*	.17	1.03	.003
Openness	2.07	.08	5.50**	.27

Let's now consider which action units accounted for the effect of intensity on the degree of change in scores between the neutral and smiling conditions. Each dimension will be reviewed separately.

Generosity

The change in generosity ratings between the two experimental conditions was affected by facial movement intensity (*Table A2.1*). Results showed that cheek raise (AU 6) and lip corner raise (AU 12) were significant predictors in the model (*Table A2.2*). This suggests that the degrees of both cheek raise and lip corner retraction significantly influence the amount of change in generosity ratings between the neutral and smiling conditions (*Figure A2.1*).

Table A2.2. Regression coefficients. dependent variable: average change between neutral and smiling for generosity ratings made by **all judges.** $^{**}p < .01$

Generosity	*B*	*SE B*	*β*	*t*
(Constant)	-0.66	0.22		-3.03**
AU 6 intensity	0.175	0.06	.35	3.08**
AU 7 intensity	4.475E-02	0.06	.09	0.79
AU 12 intensity	0.33	0.08	.52	4.05**
AU 25 intensity	-0.07	0.05	-.16	-1.27

Interestingly, when data were analysed separately for males and females, AU 6 and AU 7 were significantly and positively related to the change in generosity ratings given to *male faces*, regardless of the sex of judges (*Figure A2.1*). For female faces, all the action units were significant predictors when ratings were made by *female judges*. However, not all the action units had a positive relationship with the impact of smiling on *female judges*. Cheek raise (AU 6) and lip corner raise (AU 12) were positively related to the criterion variable whereas lid tightener (AU 7) and lip parting (AU 25) were negatively related to the impact of smiling on generosity ratings. On the other hand, the change in ratings of *female faces* by *male judges* seemed to be affected essentially by the intensity of lip corner movements (AU 12). These results suggest that the intensities of both cheek raiser and lid tightener have significant impacts on the

effect of smiling in *male faces*. Besides, the degree of both cheek raise and lip retraction could affect generosity ratings of *female faces* by *female judges* whereas only the intensity of lip corner movement would influence *male* ratings of *female faces*.

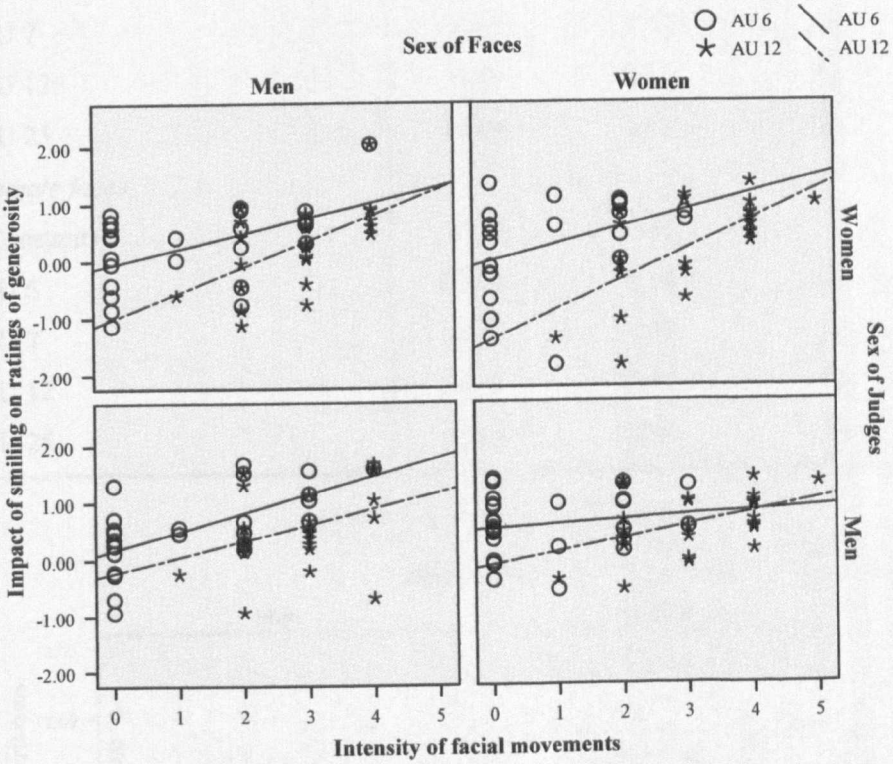


Figure A2.1. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of generosity.

Trustworthiness

The intensity of AU 12 was the only significant predictor responsible for the change in trustworthiness scores (*Table A2.3*). Further analyses showed that this effect was present when *female faces* were rated by male and female judges (*Figure A2.2*). The model was not significant when only *male faces* were considered. These results indicate that the intensity of lip corner raise could positively influence the impact of smiling on trustworthiness scores attributed to *female faces*, but not to male faces.

Table A2.3. Regression coefficients, dependent variable: average change between neutral and smiling for trustworthiness scores given by **all judges.** $^{*}p < .05$, $^{**}p < .01$

Trustworthiness	*B*	*SE B*	*β*	*t*
Male faces				
(Constant)	-0.27	0.33		-0.81
AU 6	0.04	0.07	.13	0.57
AU 7	0.05	0.07	.16	0.71
AU 12	0.14	0.13	.27	1.05
AU 25	-0.08	0.08	-.21	-1.02
Female faces				
(Constant)	-0.72	0.31		-2.28*
AU 6	0.04	0.09	.08	0.44
AU 7	-0.17	0.12	-.26	-1.4
AU 12	0.37	0.12	.69	3.07**
AU 25	-0.06	0.08	-.16	-0.72

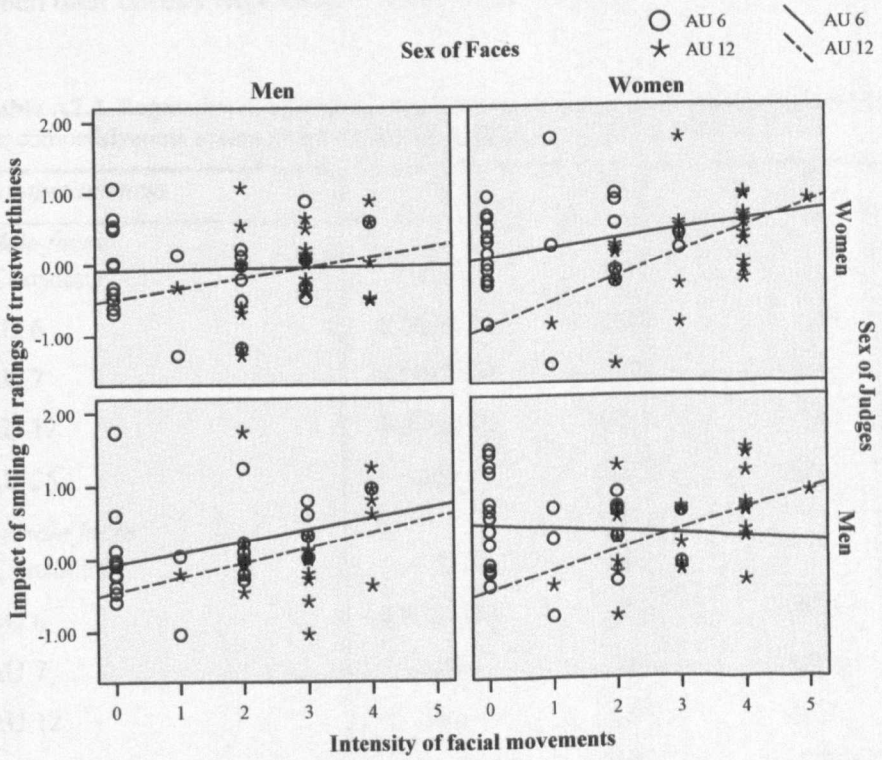


Figure A2.2. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of trustworthiness.

Competitiveness

The degree of change between neutral and smiling for ratings of competitiveness was affected by facial movements intensities mainly when judgements were performed by *female judges* (*Table A2.1*). Further analyses revealed that the intensity of facial actions influenced competitiveness scores attributed by *female judges* to *female faces*, $F(4, 20) = 4.801$, $p = .007$, $R^2_{adj} = .39$. Lip corner raise (AU 12) was the only significant predictor in the model (*Table A2.4*), indicating that the intensity of lip corner movement strongly influenced the impact of smiling on ratings of competitiveness (*Figure A2.3*). Even though the model exploring changes that occurred in *male judges* was non-significant, $F(4, 20) = 2.5$, $p = .07$, $R^2_{adj} = .33$, results suggest that cheek raise (AU 6) in *female faces* was negatively related to the impact of smiling on competitiveness ratings given by *male judges*, $\beta = -.54$, $t = -2.77$, $p = .01$. This indicates that female faces were perceived by males as being less competitive when their cheeks were deeply raised while smiling.

Table A2.4. Regression coefficients, dependent variable: average change between neutral and smiling for competitiveness scores given by **female judges**. $^{*}p < .05$, $^{**}p < .01$

Competitiveness	*B*	*SE B*	*β*	*t*
Male faces				
(Constant)	-0.11	0.37		-0.3
AU 6	8.867E-02	0.08	.25	1.06
AU 7	4.501E-02	0.07	.14	0.61
AU 12	5.625E-02	0.14	.10	0.39
AU 25	-0.06	0.09	-.14	-0.67
Female faces				
(Constant)	-1.355	.362		-3.74**
AU 6	4.904E-03	.108	.008	0.04
AU 7	-.010	.141	-.012	-0.07
AU 12	.566	.139	.844	4.09**
AU 25	-.127	.089	-.292	-1.42

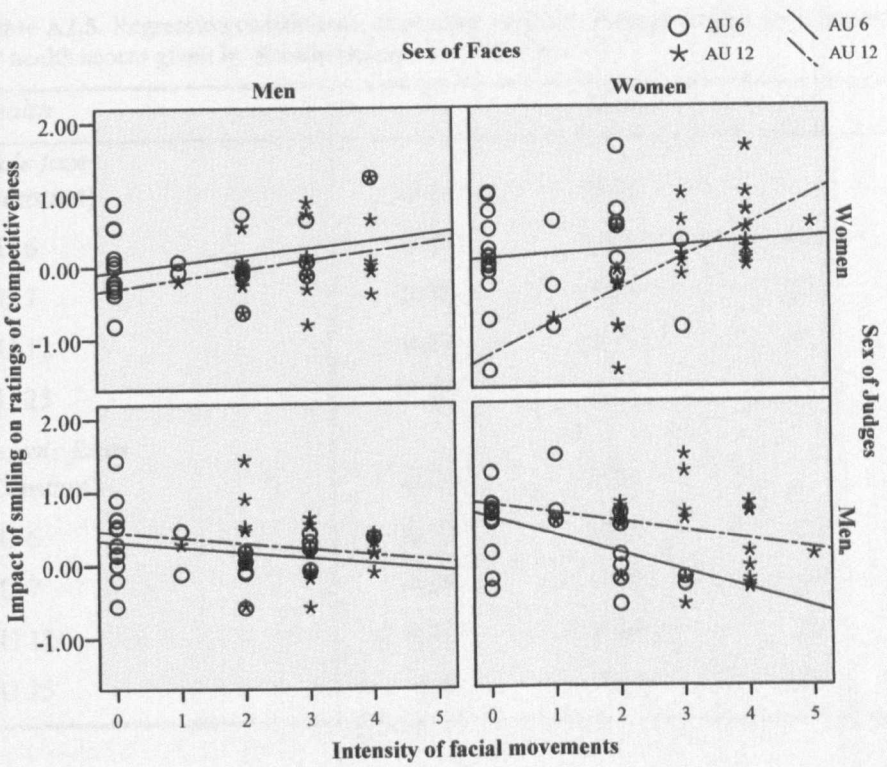


Figure A2.3. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of competitiveness.

Health

The degree of change between neutral and smiling faces for the ratings of health was significantly affected by the intensity of lip corner raise only (AU 12) (*Table A2.5*). Moreover, the impact of intensity was significant for *female judges* but not for *male judges*, regardless of the sex of the face (*Figure A2.3*). These results suggest that the level of lip corner retraction had a considerable influence on the degree of change in health ratings by *female judges*.

Table A2.5. Regression coefficients, dependent variable: average change between neutral and smiling for health scores given by **female judges**. $^{*}p < .05$, $^{**}p < .01$

Health	*B*	*SE B*	*β*	*t*
Male faces				
(Constant)	-0.34	0.28		-1.25
AU 6	-0.01	0.06	-.04	-0.21
AU 7	0.06	0.05	.21	1.07
AU 12	0.23	0.11	.49	2.18*
AU 25	0.005	0.07	.01	0.08
Female faces				
(Constant)	-0.49	0.23		-2.09*
AU 6	-0.01	0.07	-.02	-0.13
AU 7	-0.09	0.09	-.18	-1.05
AU 12	0.37	0.09	.86	4.17**
AU 25	-0.1	0.06	-0.37	-1.81

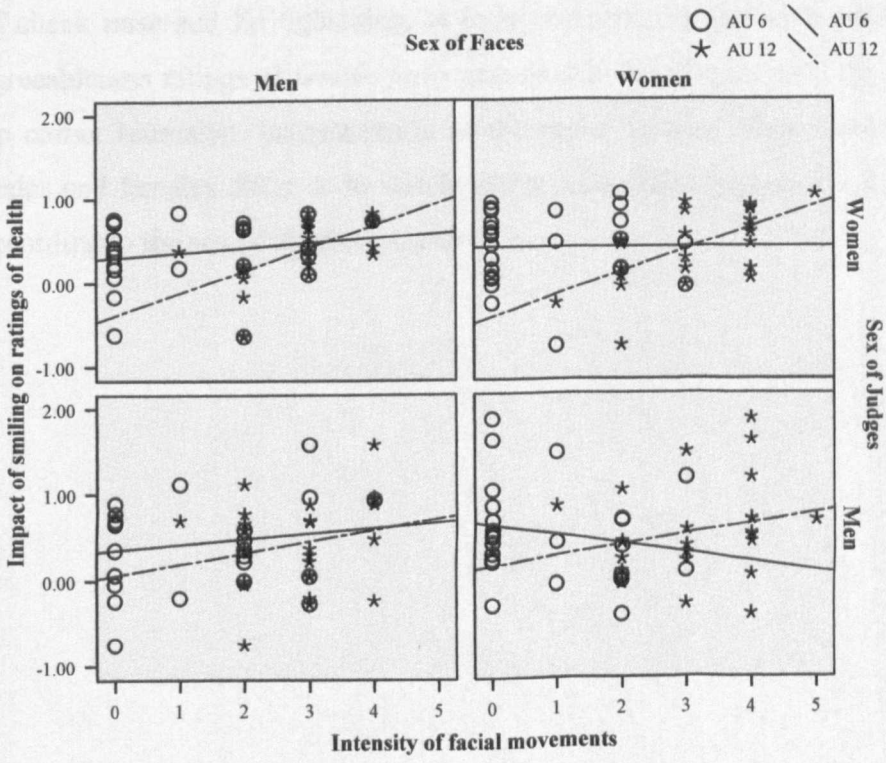


Figure A2.4. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of health.

Agreeableness

As mentioned above, the intensity of facial action units did considerably influence the degree of change in agreeableness ratings made by male and female judges (*Table A1.1*). Detailed analyses showed that AU 6, 7, and 12 had an important impact on the criterion variable, although that effect depended on the sex composition of dyads. For the ratings made by *male judges* on *male faces*, AU 6 and 7, but not AU 12, were significant predictors in the model (*Table A2.6*). On the other hand when analysis was limited to *female faces*, the intensity of lip corner raise was the only significant predictor regardless of the sex of judges (*Tables A2.6, A2.7*). The intensity of facial movements had no effect on the degree of change in agreeableness ratings given by *female judges* to *male faces*, $F(4, 20) = 1.57, p = .22$ (*Table A2.7*).

The assessment of agreeableness in *male faces* seemed to be affected by the intensity of cheek raise and lid tightening, at least when the judges were males. In contrast, agreeableness ratings of *female faces* appeared to be affected only by the intensity of lip corner retraction, independently of the sex of judges. These results suggest that males and females differ as to which action units affect judgements of agreeableness according to the sex of the face perceived.

Table A2.6. Regression coefficients, dependent variable: average change between neutral and smiling for agreeableness scores given by **male judges**. $^{*}p < .05$, $^{**}p < .01$

Agreeableness	*B*	*SE B*	*β*	*t*
Male faces				
(Constant)	0.66	0.46		1.44
AU 6	0.31	0.10	.49	3**
AU 7	0.38	0.09	.67	4.17**
AU 12	-0.25	0.18	-.27	-1.44
AU 25	-0.07	0.11	-.10	-0.64
Female faces				
(Constant)	-0.39	0.35		-1.1
AU 6	0.03	0.10	.050	0.27
AU 7	-0.23	0.14	-.317	-1.7
AU 12	0.43	0.13	.716	3.17**
AU 25	-0.12	0.09	-.303	-1.34

Table A2.7. Regression coefficients, dependent variable: average change between neutral and smiling for agreeableness scores given by **female judges**. $^{(*)}p = .06$, $^{*}p < .05$, $^{**}p < .01$

Agreeableness	*B*	*SE B*	*β*	*t*
Male faces				
(Constant)	-0.35	0.48		-0.73
AU 6	0.04	0.11	.08	0.37
AU 7	0.15	0.09	.34	1.60
AU 12	0.15	0.18	.20	0.84
AU 25	-0.03	0.11	-.06	-0.29
Female faces				
(Constant)	-1.32	0.43		-3.08**
AU 6	0.13	0.13	.17	1.04
AU 7	-0.33	0.17	-.33	-1.99(*)
AU 12	0.6	0.16	.74	3.65**
AU 25	-0.08	0.11	-.16	-0.77

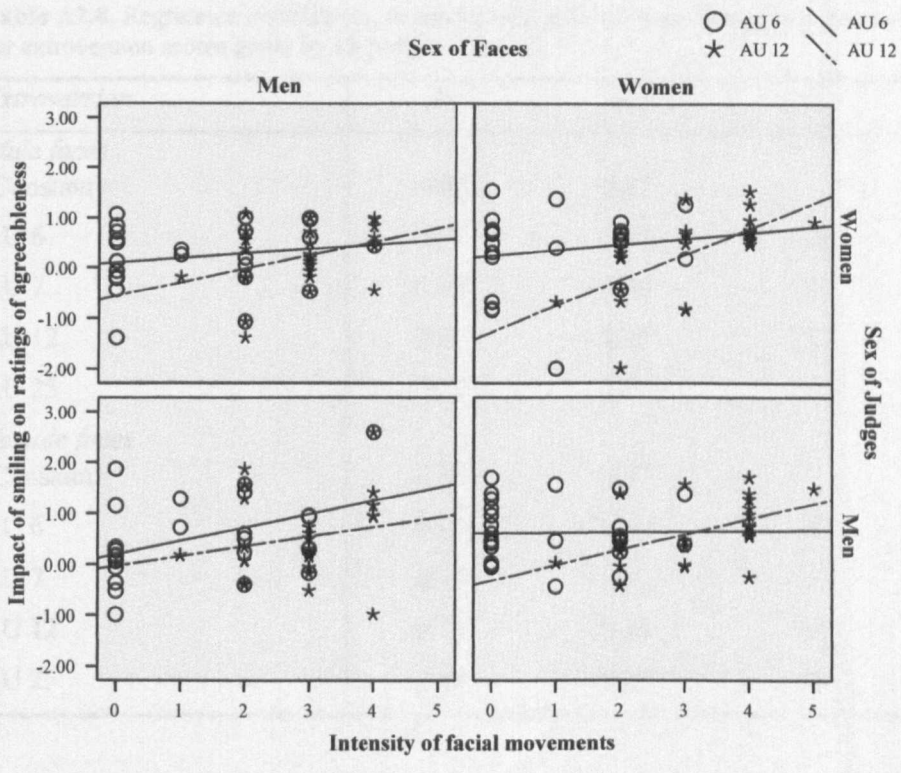


Figure A2.5. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of agreeableness.

Extroversion

The impact of smiling on extroversion ratings was highly influenced by the intensity of facial action units. Results showed that AU 6 and 12 were mainly responsible for that effect, regardless of the sex of judges. On the other hand, AU 7 and 25 did not come out as significant predictors in the model (*Table A2.8*). Further analyses taking the sex of faces into account yielded interesting results. The changes in judgements of *male faces* on extroversion were affected by the intensity of AU 6, but not AU 12; whereas judgements made on *female faces* were influenced by the strength of AU 12, but not AU 6 (*Table A2.8*). These results suggest that although changes between neutral and smiling in extroversion ratings can be highly influenced by the degree of both cheek raise and lip corner retraction, these two action units had different impacts on receivers depending on the sex of faces under evaluation.

Table A2.8. Regression coefficients, dependent variable: average change between neutral and smiling for extroversion scores given by **all judges**. $^{**}p < .01$

Extroversion	*B*	*SE B*	*β*	*t*
Male faces				
(Constant)	-0.85	0.47		-1.81
AU 6	0.3	0.10	.48	2.84**
AU 7	0.15	0.09	.27	1.65
AU 12	0.21	0.18	.22	1.15
AU 25	0.11	0.11	.16	1.02
Female faces				
(Constant)	-1.79	0.37		-4.83**
AU 6	0.16	0.11	.20	1.49
AU 7	-0.14	0.14	-.13	-0.98
AU 12	0.74	0.14	.84	5.20**
AU 25	-0.04	0.09	-.08	-0.48

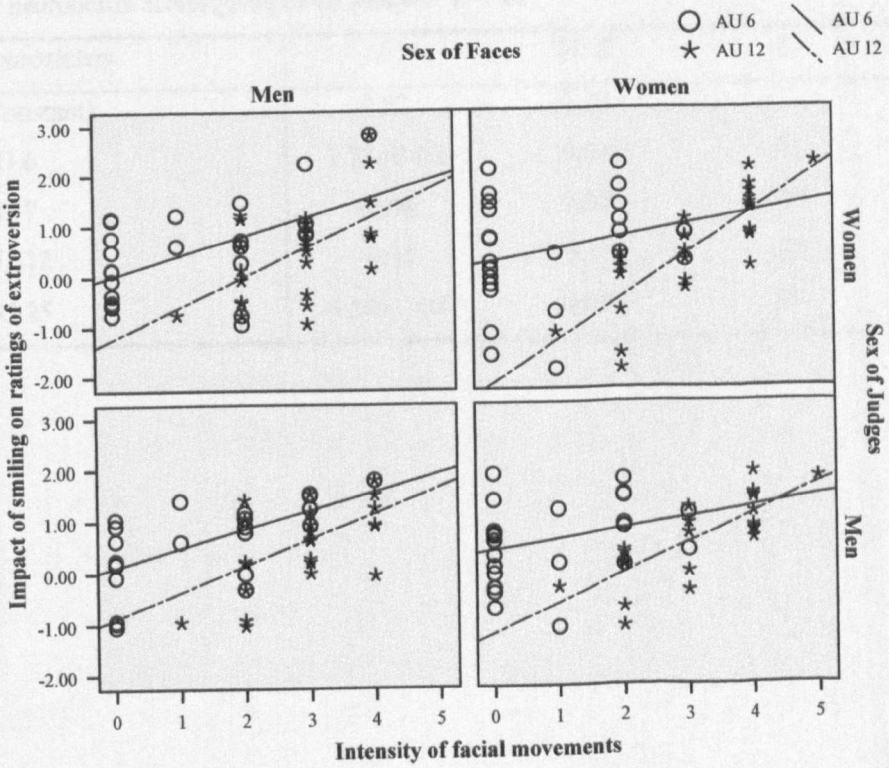


Figure A2.6. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of extroversion.

Neuroticism

The intensity of facial movements had a significant effect on the degree of change between neutral and smiling for ratings of neuroticism only when these ratings were made by *male judges* (*Table A2.1*). As shown in *Table A2.9*, the intensity of lip corner retraction was the only significant predictor in the model, whereas the other action units – AU 6, 7, and 25 – were not. The strength of AU 12 was negatively related to the change in neuroticism ratings, indicating that judgements of neuroticism made by males tended to drop as lip corner raise intensity increased (*Figure A2.7*). This trend seemed to be particularly apparent when *female faces* were rated by *male judges*, even though the model specific to this type of dyad was not statistically significant, $F(4, 20) = 1.77, p = .17$.

Table A2.9. Regression coefficients, dependent variable: average change between neutral and smiling for neuroticism scores given by **all judges**. $^{**}p < .01$

Neuroticism	*B*	*SE B*	*β*	*t*
(Constant)	0.52	0.28		1.83
AU 6	7.734E-03	0.07	.01	0.10
AU 7	-0.04	0.07	-.07	-0.52
AU 12	-0.35	0.11	-.51	-3.29**
AU 25	4.543E-02	0.07	.09	0.64

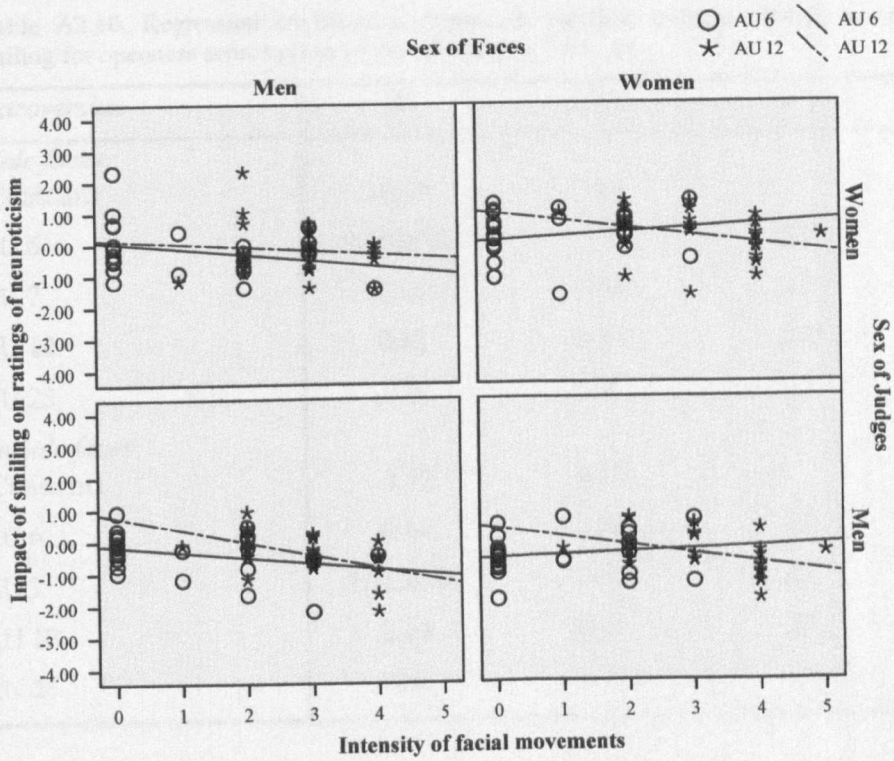


Figure A2.7. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of neuroticism.

Openness to experience

The change in openness scores observed between neutral and smiling faces was significantly related to facial action units' intensity only when these ratings were made by *female judges* (*Table A2.1*). Again, AU 12 was the only significant predictor in the model. An analysis conducted separately for each sex showed that the effect of lip corner raise intensity did significantly influence openness ratings made by *female judges* on *female faces* (*Table A2.10*). These results suggest that the strength of lip corner retraction does significantly affect the degree of change in ratings of openness when these scores were given by *female judges* to *female faces*.

Table A2.10. Regression coefficients, dependent variable: average change between neutral and smiling for openness scores given by **female judges**. $^{**}p < .01$

Extroversion	*B*	*SE B*	*β*	*t*
Male faces (Constant)	-0.04	0.43		-0.09
AU 6	9.300E-02	0.1	.21	0.97
AU 7	0.12	0.08	.30	1.45
AU 12	0.15	0.17	.22	0.91
AU 25	-0.09	0.10	-.17	-0.89
Female faces (Constant)	-1.52	0.44		-3.47**
AU 6	0.14	0.13	.18	1.05
AU 7	3.365E-02	0.17	.03	0.2
AU 12	0.59	0.17	.73	3.51**
AU 25	-0.1	0.11	-.18	-0.89

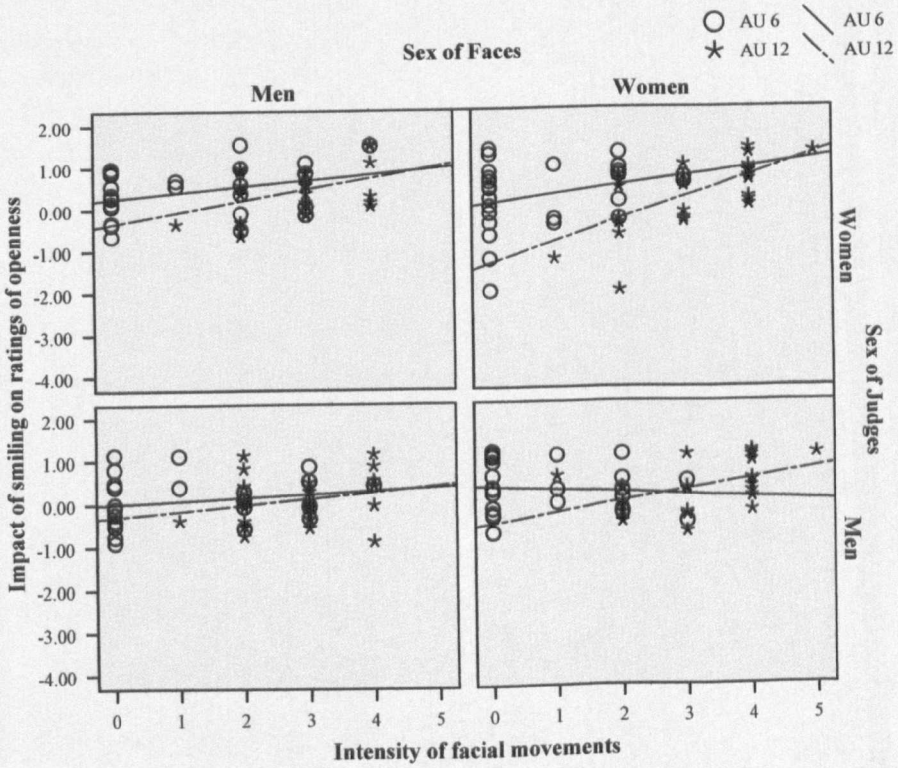


Figure A2.8. Effect of facial movement intensity (AU6, cheek raiser and AU12, lip corner puller) on the difference between neutral and smiling for ratings of openness.

Discussion

This section showed that the impact of smiling on the judgements of traits by men and women could depend on the intensity of facial movements. In addition, the effect of individual action units depended not only on the trait under evaluation but also on the sex of faces and judges. Overall, facial movements intensity had a greater impact on judgements made by women than on those made by men, indicating that women are more sensitive to alteration of subtle facial actions. In addition, the impact of smiling on social judgements seemed to be independent from the degree of mouth opening. Finally, men could benefit from displaying emotional cues when advertising traits that are potentially adaptive for receivers (e.g. agreeableness, extroversion, and generosity).

Appendix Three

QUESTIONAIRES USED IN THE BARGAINING EXPERIMENT

A3.1. Background information

Date: **Time:** **Pseudoname:**

1. Age:

2. Sex: o man o woman

3. What is your highest school qualification?

OVolksschule (Primary school)
OHauptschule (Secondary school)
OFachschule/Berufsschule (Technical college)
OMatura (A-level)
OFachhochschule (Polytechnic)
OUniversität (University)

4. What is your job?

5. What is your salary (in euros)?

o under 1000 o 1000-1750 o 1750-2500 o 2500-3250 o more

6. How important for you is money in general?

not at all _____ very

7. What is your sexual orientation?

o heterosexual o homosexual o bisexual

8. Have you got a partner at the moment? o yes o no

9. If yes, for how long?

10. How happy are you in your relationship?

unhappy _____ very happy

11. Are you married? o yes o no

12. If yes, for how long?

13. Have you got children? How old are they?

14. Whom do you live with?
For how long?

15. Are you at the moment looking for a partner?

not at all _____ very

16. Have you got brothers and sisters? How old are they?

17. How well can you rely on these people?

Father
not at all _____ very much

Mother
not at all _____ very much

Brother/Sister
not at all _____ very much

Partner
not at all _____ very much

Family other
not at all _____ very much

Friends
not at all _____ very much

Acquaintances
not at all _____ very much

18. What role do the following people/factors play in your life?

Father
little _____ very big

Mother
little _____ very big

Brother/Sister
little _____ very big

Partner
little _____ very big

Children
little _____ very big

Friends
little _____ very big

Acquaintances
little _____ very big

Family other
little _____ very big

Career
little _____ very big

A3.2. Friendship Questionnaire

This questionnaire is strictly confidential. It is aimed at assessing the quality of the relationship between you and your friend here present. Please try to be as honest as possible. There is no right or wrong response, and your friend will not know about your answers.

1. Who is your friend: a colleague, a housemate, a study pal, or other?
2. How long have you known each other for? ... Months ... Weeks ... Days
3. What is your frequency of contact (on a weekly basis):
4. Do you feel comfortable having one-to-one interactions with your friend?

Not at all Very comfortable

---

5. How often do you talk about personal matters with your friend?

Never Always

---

6. How often do you share activities with your friend (e.g. sport, games, etc).

Never Always

---

7. How RELIABLE do you consider your friend?

Not at all Very much

---

8. How GENEROUS do you consider your friend?

Not at all Very much

---

9. How TRUSTWORTHY do you consider your friend?

Not at all Very much

---

10. How CLOSE do you feel to your friend?

Not at all Very much

---

11. How DOMINANT do you feel your friend is?

Not at all Very much

---

12. How SUBMISSIVE do you feel your friend is?

Not at all Very much

---

13. How BALANCED do you feel the RELATIONSHIP with your friend?

Not at all Very much

---

14. How much do you like your friend?

Not at all Very much

---

15. Would you ask your friend for financial support if you were in need?

Certainly not By all means

---

16. How much do you desire your friend as a sexual partner?

Not at all Very much

---

17. How much do you desire your friend as a love partner?

Not at all Very much

---

18. Imagine that your friend has got financial problems and he/she asks you for support. How much of your income would you be ready to spend to help him/her?

0% 100%

---

19. Do you (or have you) live (d) with your friend?

YES – NO (please circle your answer)

If YES, how easy is (or was) it for you to live with your friend?

Not easy at all Very easy

If NO, imagine that your friend has been thrown out of his/her apartment and that he/she's asking you to stay at your place for some time. How long would you be ready to take him at your home?

0 day 100 days

---

20. How well do you know your friend?

Not at all Very well

---

21. How IMPORTANT is friendship to you in general?

Not at all Very much

---

22. Has there been a recent event that might have made the relationship slightly unbalanced (e.g. financial debt, a favor given that hasn't been reciprocated, etc.)? **YES – NO (please circle your answer)**

A3.3. Emotional State

HOW ARE YOU FEELING RIGHT NOW?

ANGRY

Not at all _____ Very much

HAPPY

Not at all _____ Very much

SURPRISED

Not at all _____ Very much

SCARED

Not at all _____ Very much

SAD

Not at all _____ Very much

DISGUSTED

Not at all _____ Very much

RELAXED

Not at all _____ Very much

A3.4. Altruism Scale

(reproduced from Johnson *et al.*, 1989.)

T=time; T/E=time and effort (or pain); M/G=money or goods; R=risk of physical or psychological harm; LS=loss of status or of potential gain of status.

1. I have helped push or restart a stranger's vehicle when it was stalled. (T/E)
2. I have given directions to a stranger. (T)
3. I have made change for a stranger. (T)
4. I have given money to a charity. (M/G)
5. I have given money to a stranger who needed it (or asked me for it). (M/G)
6. I have donated goods or clothes to a charity. (M/G)
7. I have done voluntary work for a charity. (T)
8. I have donated blood. (T/E)
9. I have helped carry a stranger's belongings (books, parcels, etc.). (T/E)
10. I have delayed an elevator and held the door open for a stranger. (T)
11. I have allowed someone to go ahead of me in a line or queue. (T)
12. I have given a stranger a lift in my car. (T)
13. I have pointed out a clerk's error (in a bank, at the market) in undercharging me for an item. (M/G)
14. I have let a neighbor whom I didn't know too well borrow an item of some value to me (e.g. a dish, tools, etc.). (M/G)
15. I have paid a little more to buy an item from a merchant who I felt deserved my support. (M/G)
16. I have helped a classmate who I did not know that well with a homework assignment when my knowledge was greater than his or hers. (T)
17. I have looked after a neighbor's pet without being asked and without being paid for it. (T)
18. I have offered to help a handicapped or elderly stranger across a street. (T)
19. I have offered my seat on a bus or tram to a stranger who was standing. (T/E)
20. I have helped an acquaintance to move households. (T/E)
21. I have helped a neighbor whom I didn't know that well work on his or her house. (T/E)
22. I have absorbed the blame for the mistake of a colleague when he or she needed the help. (LS)
23. I have done something I honestly felt was wrong in order to help someone I didn't know that well out of trouble. (LS)
24. I have helped someone I didn't know get up when (s)he slipped or tripped and fell down. (T)
25. I have helped an acquaintance obtain something important that he or she needed (e.g. a job, a place to live, etc.). (T)
26. I have worked passed my shift to help someone make a productive quota. (T)
27. I have called the police after witnessing a crime and identified myself. (R)
28. I have shared credit for an accomplishment when I could easily have taken it all. (LS)
29. I have "bent the rules" to help someone I didn't know that well. (LS)

30. I have helped a new fellow-employee at work get settled on the job and learn the tasks involved, even though it wasn't part of my job. (T)
31. I have moved my car into a dangerous position to avoid hitting a pedestrian. (R)
32. I have helped an acquaintance out of a personally embarrassing situation and kept it confidential for his or her sake. (LS)
33. I have volunteered to nurse an acquaintance who was ill. (T/E)
34. I have helped a neighbor who needed it to harvest his crops. (T/E)
35. I have defended someone I didn't know from being physically harmed. (R)
36. I have deceived someone when I felt it was for their own good. (LS)
37. I have voluntarily served as witness in a court of law. (R)
38. I have loaned my car to friends or neighbors. (M/G)
39. I have calmed someone I didn't know who was behaving in a visibly disturbed or frightened manner in public. (R)
40. I have walked a stranger through a dangerous area (e.g. neighborhood, parking lot, etc.). (R)
41. I have sacrificed a parking place for a stranger. (T)
42. I have stuck my neck out to "cover for" a work-mate. (LS)
43. In heavy traffic, I have slowed to let someone coming toward me make a turn in front of me even though it meant having to wait through the red light. (T)
44. I have stopped on a highway to help a stranger fix a flat tire. (T/E)
45. When playing a team sport, I often sacrifice an opportunity to score when I see that another player has a better chance. (LS)
46. I have "picked up the slack" for another worker when he or she couldn't keep up the pace. (T)
47. As part of a group of people, I have done menial jobs that needed doing without being asked even though they were not part of my responsibilities. (T)
48. I have been offered responsibilities at work, which I have declined in favor of a more qualified colleague. (LS)
49. On occasion, I have "stretched the truth" to help someone out of an embarrassing situation. (LS)
50. I have taken a lost child to a store manager so its parents could be found. (T)
51. I have saved someone's life (e.g. from drowning, from a fire, etc.). (R)
52. I have answered the questions of someone doing a door-to-door survey or a telephone survey. (T)
53. I have volunteered to work in a hospital. (T/E)
54. I have contributed my time and labor to community improvement activities. (T/E)
55. I have attempted to calm someone who was behaving in a frighteningly strange or psychotic fashion. (R)
56. I have worked on a committee of a legal but unpopular minority organization. (LS)

A3.5. Quiz Game (german)

Date: **Pseudoname:**

QUIZ GAME!

You have five minutes to answer as many questions as possible. Please answer fast and do not hesitate to pass to the next question when you do not know the answer.

Good Luck!!

1. Wie bezeichnet man den Montag in der Fastnachtswoche?
2. Was sind Frischlinge?
3. Wofür steht das Kürzel z.B.?
4. Wie nennt man das Geld, das man bei der Rückgabe von Leihflaschen erhält?
5. Der Name welcher Spielkarte dient verliebten Männern als Bezeichnung für ihre Angebetete?
6. Was bedeutet in der Schülersprache der Begriff schwänzen?
7. Was wird als Sprit bezeichnet?
8. Zu welcher Kinder-TV-Serie gehören Kermit und das Krümelmonster?
9. Was ist ein Fauteuil?
10. Wie heißt Österreichs Bundeskanzler seit 2000?
11. Für welche nichtgesetzliche Einheit der Leistung steht die Abkürzung PS?
12. Wie nennt man die Lautäußerungen von Tauben?
13. Was war Egon Schiele von Beruf?
14. Was für ein Landsmann ist der Formel-1-Rennfahrer Mika Häkkinen?
15. Wie nennt man eine Wasserstelle in der Wüste?
16. Was bedeutet GmbH?
17. Wie heißt der längste Fluss Afrikas?
18. Wo trägt man ein Monokel?
19. Die Früchte welches Baumes nennt man Eckern?
20. Welcher Pass verbindet die Steiermark und Niederösterreich?
21. Wie nennt man einen Wirbelsturm, der Staub und Sand mit sich führt?
22. Wovon lebt der Mensch der Bibel zufolge nicht allein?
23. Wo wohnt der Papst?
24. Welche Straße gab der New Yorker Aktienbörse den Namen?
25. Wie heißt der Begründer der Psychoanalyse?
26. Wie begrüßt man sich in Italien?
27. Wie nennt man ein Jazzorchester?
28. Zu welchem Thema verabschiedete der Nationalrat in Österreich am 26.10.1955 ein Bundesverfassungsgesetz?
29. Wo orakelte man im alten Griechenland?
30. Zu welcher Stadt zählt Wimbledon?
31. Wie nennt man die kürzeste Verbindung zwischen zwei Punkten?
32. Wie heißt die bei der Kommunion in der katholischen Kirche gereichte Oblate?
33. In welchem Jahr wurde Franz Klammer in Innsbruck Olympiasieger?
34. Wonach schmeckt Bärlauch?
35. Wie heißt die dritte CD von Austria 3?
36. Wer entdeckte die Mitwirkung von Bakterien an der Gärung?

37. Durch welche Rolle wurde Helmut Qualtinger zur Symbolfigur des österreichischen Kabaretts?
38. In welchem Bundesland befindet sich der Nationalpark Nockberge?
39. Wie bezeichnet man die Zeitspanne zwischen den beiden Weltkriegen?
40. Was sind Quäker?
41. Für welchen Handwerker zählt es zum Berufsalltag, etwas über den Leisten zu ziehen?
42. Wie nennt man einen Fußballspieler, der zu seinem ersten Einsatz in der Nationalelf kommt?
43. Wie heißt das älteste erhaltene Kunstwerk Österreichs?
44. Mit welcher Abkürzung wird ein mindestens fünf Jahre alter Cognac gekennzeichnet?
45. Wie lautet der skandinavische Begriff für eine weit ins Festland vordringende Meeresbucht?
46. Wie nennt man hochgebildete japanische Gesellschafterinnen?
47. Wer spielt Hauptrollen in den Filmen „Saturday Night Fever" und „Pulp Fiction"?
48. Was ist ein „Sturm" am Anfang des Herbstes?
49. In der Nähe welcher große europäische Stadt befindet sich ein Disneyland?
50. Welcher Vogel der antiken Mythologie verbrennt sich selbst und steigt aus seiner Asche wieder auf?
51. Was war in den USA während der so genannten Prohibition verboten?
52. Wie nennt man die Nomaden der arabischen Steppen und Wüsten?
53. Welche Wissenschaft beschäftigt sich mit der Entwicklungsgeschichte und dem Aufbau der Erde?
54. Welchem 26-jährigen Vorarlberger Musiker gelang mit dem Album „One to make her Happy" der Sprung in die deutschen Charts?
55. Wie heißt das berühmte Schirennen in Kitzbühel?
56. Wie wird der Strafraum eines Fußballfeldes auch bezeichnet?
57. An welchem Baum reifen Maronen heran?
58. Wie heißt der gröste Steppensee Österreichs?
59. Aus welchem Land nahm Österreich 1956/57 zigtausende Flüchtlinge auf?
60. Was ist eine Schaluppe?
61. Wo befindet sich die Amundsen-Scott-Forschungsstation?
62. Wer schrieb „Hanni und Nanni" sowie die Abenteuergeschichten der „Fünf Freunde"?
63. Wie heißt das Etablissement, das Humphrey Bogart in „Casablanca" betreibt?
64. Aus welcher Stadt kamen die Beatles?
65. Wie bezeichnete man in der früheren Sowjetunion die Astronauten?
66. Wie wurde das Basketball-Team der USA genannt, das bei den Olympischen Spielen von 1992 Gold gewann?
67. Welcher US-Präsident wurde 1963 bei einen Attentat getötet?
68. Wer ging in die Unterwelt, um seine Frau Eurydike zurück ins Reich der Lebenden zu holen?
69. Wie hoch ist der Großglockner?
70. Wie nennt man den Raum einer Techno-Disco, in dem man sich bei sanfter Musik erholen kann?
71. Wo wurde nach dem Sturz Napoleons die territoriale Neuordnung Europas 1814/1815 diskutiert?
72. Wen löste Tony Blair 1997 als Premier-Minister von Großbritannien ab?
73. Von welcher Band stammt der Rock-Klassiker „Smoke on the Water"?
74. Unter welchem grammatikalischen Begriff fasst man die Wörter „der, die, das" zusammen?
75. Wie lautet der zweite Vorname des ehemaligen Weltklasse-Fußballer Diego Maradona?
76. Wie heißt die Haupstadt der Schweiz?
77. Was war James Joyce?

78. Wie heißt die Frau von Spaniens König Juan Carlos?
79. Wo (welche lander) wurde die Band AC/DC gegründet?
80. Wo wird der Formel-1-Grand-Prix von Belgien ausgetragen?
81. Welche Farbe haben die Blüten der Sumpfdotterblume?
82. Was stellt ein Hafner her?
83. Wer wählt die beiden Präsidenten des Rechnungshofs?
84. Wie nennt man ein längliches, cremegefülltes und mit Glasur überzogenes Gebäckstück?
85. Wie heißt die Liste der Personen, die an einer Hochschule studieren?
86. Wer wurde 1976 und '84 Olympiasieger sowie 1983 und '87 Weltmeister im 400-Meter-Hürdenlauf?
87. Wie heißt das Dienstflugzeug des amerikanischen Präsidenten?
88. Wie heißt der Nationalheilige Irlands?
89. In welchem Roman zeigt Heimito von Doderer Wiens Gesellschaft Anfang des 20. Jahrhunderts?
90. Welche Stadt wurde 1712 unter Zar Peter dem Großen zur Hauptstadt Russlands?
91. Wer spielt den Kannibalen Hannibal Lecter in dem Film „das Schweigen der Lämmer"?
92. Welcher Schlange wuchsen für jeden abgeschlagenen Kopf zwei neue nach?
93. Wie bezeichnet man einen mexikanischen Cowboy?
94. Zu welcher Inselgruppe zählt Teneriffa?
95. Wie heißt der türkische Anisbranntwein?
96. Zu welcher Vogelfamilie gehört der Wellensittich?
97. Aus welcher Mozart-Oper stammt die Figur des Sarastro?
98. Auf welcher Insel befindet sich der Vulkan Mauna Loa?
99. Wieviel Bezirke gibt es in Wien?
100. Wer entwarf in den Siebzigern die Garderobe der Sex Pistols?

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