

# Naturalistic observations of smiling and laughter in human group interactions

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(Accepted: 17 April 2008)

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## Summary

Although smiling and laughter have received considerable attention from researchers, little is known about the way they are displayed in naturally occurring group interactions. This aspect could be crucial if we want to understand the function of affiliative behaviours in social relationships. Naturalistic observations were conducted in areas where people could be watched interacting in small groups. Focal sampling of men and women allowed the recording of smiling and laughter frequencies, as well as group size and composition in terms of age and sex. Overall, smiling and laughter were influenced by group size and age of people involved. Smiling and laughter were also affected by other aspects of social context, depending on the type of behaviour concerned and the sex of individuals. By deriving predictions from three hypotheses — sexual advertisement, social competition, and cooperation — this study revealed that smiling and laughter are likely to be involved in the formation of cooperative relationships.

*Keywords:* smiling, laughter, field study, group interactions, sexual advertisement, social competition, cooperation.

## Introduction

Smiling and laughter are social behaviours. First, because their frequency of occurrence increases in social as opposed to solitary contexts (Mackey, 1976; Kraut & Johnston, 1979; Fridlund, 1991; Provine, 2000), and second,

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because they have been linked to interactive consequences such as parental care (Ambrose, 1961), a greater leniency from judges after committing minor offences (Forgas et al., 1983; LaFrance & Hecht, 1995), monetary benefits (Tidd & Lockard, 1978; Brown & Moore, 2002), and positive social judgements (Otta et al., 1994; Bachorowski & Owren, 2001; Mehu et al., 2007). 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, 1997). It should be noted, however, that laughter could merely function to alter listener's affective state rather than communicate specific information about the sender (Owren & Bachorowski, 2003).

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. Specifying the context in which a behaviour occurs is one way to approach its function (Hinde, 1975). Three different social arenas were identified as relevant to the function of social behaviour because they are directly or indirectly related to reproductive success: sexual advertisement, 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 frequencies of smiling and laughter.

### *The sexual advertisement hypothesis*

In a field study conducted in bars, smiling was found to be a recurrent display in women's courtship behavioural repertoire (Moore, 1985; Moore & Butler, 1989). In addition, 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; Jones et al., 2006; Mehu, 2006). Neurobiological research also showed that the rewarding value of an attractive face can be increased by the presence of a smile (O'Doherty et al., 2003). So, smiling may occur as part of courtship, to enhance one's appeal.

Laughter could also play a role in mating contexts. For example, a woman's interest in a male partner could be predicted by the number of times she joined the man in laughing, and by the number of instances she laughed (Grammer & Eibl-Eibesfeldt, 1990). Another interesting finding was that the

presence of a male audience appeared to be particularly strong in producing laughter in women speakers (Provine, 1993; Smoski & Bachorowski, 2003). In a different study, sexiness ratings attributed to female voiced laughs were higher when given by male than by female listeners (Bachorowski & Owren, 2001). These results suggest that laughter could be, at least for women, a signal of interest in a potential partner.

### Predictions of the sexual advertisement hypothesis

A key prediction of the sexual advertisement 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. In addition, within mixed-sex groups smiling and laughter should be primarily directed to opposite-sex individuals.

The effect of age on courtship displays should differ according to sex. Because women'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's smiling and laughter should be higher in young than in mature women. However, 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 a male's reproductive success, men's smiling and laughter rates should be unrelated to their age. Finally, the frequency of smiling and laughter should increase with the number and the proportion of opposite-sex partners, as one should expect sexual displays to be more frequent when mating opportunities are larger.

### *The competition hypothesis*

The second hypothesis relies on the assumption that smiling and laughter could function to acknowledge hierarchical relationships and help avoid the risks resulting from agonistic interactions. Non-human primate literature indeed suggests that some displays could function to implement social hierarchy in day-to-day 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 (van Hooff, 1972), would function to communicate a submissive position (de Waal & Luttrell, 1985; Preuschoft,

1992). In other species, however, the meaning of this behaviour seems 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).

The emancipation of the display over the course of evolution does not preclude it is still being 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 has been largely documented (Mealey, 1985; Müller & Mazur, 1998). Signs of dominance or deference may include physical threats or submissive cowering, erect or cramped posture, direct gaze or eye aversion, advancing on someone or retreating, relaxed and confident demeanour or nervous fidgeting (Weisfeld & Linkey, 1985; Mazur, 2005). Psychological research also suggests that smiling might still be part of dominance relationships. For example, while studying competitive interactions in children, Schneider & Josephs (1991) found that losers smiled more frequently and more intensely than winners. In addition, non-smiling people are usually perceived as dominant (Keating et al., 1977, 1981). Finally, Schmid-Mast & 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.

Laughter could share the appeasing function of smiling. Given that laughter could be seen as a reward for people who engage in the production of humour, this behaviour could be used by subordinates to flatter dominant individuals (Weisfeld, 1993). There is evidence that people are prone to express appreciation for the boss' jokes, as a way to show admiration towards them (Fry, 1977; Kane et al., 1977; both cited in Weisfeld, 1993). Eibl-Eibesfeldt (1989) proposed that laughter could function to repel deviant or non-conforming individuals. In that sense, laughter could act as a conformity pressure which effect would bond companions who are laughing together at outsiders (mobbing effect). This fits, to some extent, with the proposal that some forms of humour would function to alter the status of individuals ostracized from coalitions (Alexander, 1986). More recently, Platow and colleagues (2005) showed that laughter of in-group members has a more positive impact on subjective judgements than laughter of out-group members. It follows that laughter's appeasing function could be particularly

relevant to in-group relationships, possibly to reassert the desire to be part of a dominant individual's coalition.

The presence of other people is known to influence behaviour through facilitation effects (Zajonc, 1965) and emotional contagion (Hatfield et al., 1994). For example, people who are exposed to humorous stimuli tend to laugh and smile more when they hear laughter, both when the audience is physically present (Chapman & Wright, 1976) or absent (Brown et al., 1982; Martin & Gray, 1996). The power of laughter to elicit laughter is largely exploited in the television industry through the use of canned laughter in soap operas and comedy shows. Crowding effects have also been described when high density (i.e., larger group size, or smaller room size) combined with a laughing model increased rates of laughter (Freedman & Perlick, 1979; Levy & Fenley, 1979). These studies suggest that the number of people around should influence laughter and smiling in groups. Unfortunately, these authors rarely frame their results in a functional evolutionary perspective. It is possible that the composition of groups (in terms of age and sex) mediates the effect of group size on smiling and laughter rates, for reasons related to social competition.

Increased competition in larger groups could be driven by a higher number of social contacts, competition for mates or cooperative partners, or decreased familiarity with people leading to a need to establish dominance relationships. In mammals, higher densities of animals are traditionally associated with increased rates of aggression (Calhoun, 1962; Kummer & Kurt, 1965; Southwick, 1969). However, primates seem to be particularly good at keeping aggression under control through the use of appeasement displays and affiliative behaviours (Nieuwenhuijsen & de Waal, 1982; de Waal, 1989; Judge & de Waal, 1997). In humans, the large population densities typical of modern society suggest that individuals developed behavioural strategies to cope with social tension provoked by crowding. Smiling and laughing might well be part of those strategies.

### Predictions of the competition hypothesis

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 individuals should laugh and smile more than mature ones when observed in mixed-age groups. This age difference should be absent when men interact in same-age groups.

If smiling functions to communicate 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. Assuming that age is a good indicator of status, the age composition of groups should have an impact on smiling rates, which should be higher in mixed-age than in same-age groups. In addition, 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.

Cashdan (1998) noticed that men smile less than women in tense situations, for example interactions with strangers. This finding could be explained by a combination of two interesting facts: dominance is a central dimension of male relationships (Betzig, 1986), and non-smiling faces are perceived as being dominant (Keating et al., 1977, 1981). In addition, men tend to show 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 the predicted direction. Finally, there is no particular reason to expect a sex difference in laughter rates under the competition hypothesis.

Because more competition is expected in larger groups, smiling and laughter rates should increase in line with group size. Moreover, in mixed-sex groups, smiling and laughter rates should increase with the proportion rather than with the number 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 (or the proportion of men) while men's displays should be positively related to the sex ratio. Finally, in mixed-sex groups, smiling and laughter should be mainly directed at same-sex individuals.

### *The cooperation hypothesis*

Repeated interactions between unrelated individuals is a persistent feature of human groups (Dunbar, 1996a) and represent the ground on which recipro-

cal altruism can evolve (Trivers, 1971). However, constant failure to reciprocate would lead to social exploitation, a situation that is also known as the free-rider issue (Dunbar, 1999). Although cheater-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). Moreover 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, because emotion-based expressions are difficult to produce voluntarily (Ekman & Friesen, 1982; Ekman et al., 1983; Gazzaniga & Smylie, 1990), they could constitute reliable signals of altruistic dispositions and intentions (Hirschleifer, 1987; Frank, 1988). The sharing of positive emotions through spontaneous (or Duchenne) smiles has, therefore, been proposed to be a major solution to resolve commitment problems (Brown & Moore, 2002; Brown et al., 2003). Finally, spontaneous smiles could be particularly relevant to social contexts that involve the sharing of material resources (Mehu et al., 2007).

Implicit in the proposal that humour and laughter function to ostracize out-group members (Alexander, 1986; Eibl-Eibesfeldt, 1989) is the idea that laughter acts to reinforce social bonds within a coalition. Other theoretical accounts on the evolution of laughter suggested that it evolved to foster cooperative relationships (Dunbar, 1996b; Owren & Bachorowski, 2001; Gervais & Wilson, 2005). Interestingly, laughter has been shown to improve cohesiveness and cooperation in goal-oriented groups (Banning & Nelson, 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.

### Predictions of the cooperation hypothesis

Research on social networks showed that mature men tend to give equal importance to their friends and family, while women's relationships in later years seem to involve more contacts with children (Due et al., 1999). This suggests that, at least in some cultures, age has an effect on social relationships, depending on the sex of individuals. Therefore, 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.

Men and women tend to have more people of their own sex in their social networks (Dunbar & Spoors, 1995; Roberts et al., 2007). 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's smiling and laughter should not necessarily be affected by the sex composition of groups. If social alliances are believed to be more fertile when they involve people who are somehow similar to each other (Newcomb, 1961; Zeggelink, 1995), then smiling and laughter should also be displayed at higher rates in same-age groups than in mixed-age groups.

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 (see also Noë & Hammerstein, 1995). Therefore, smiling should be positively related to group size. Similarly, if laughter promotes group cohesion, one should also expect it to be positively related to group size, as larger groupings might require a higher level of cohesiveness than smaller parties. Finally, in mixed-sex groups smiling and laughter should be primarily directed to same-sex individuals.

## **Method**

### *Subjects*

A total of 212 human individuals was sampled. People's age was roughly estimated by the observation of physical appearance, and they were classified in two categories: young (less than 35 years old) and mature (over 35 years



old). The number of men and women taking part in the interaction was recorded and was used to define the composition of groups in terms of age and sex. Mixed-sex groups included both men and women, whereas same-sex groups included either men or women. Mixed-age groups were composed of individuals of different age classes while same-age groups were composed of people from the same age class. Due to restrictions imposed by anonymity, no systematic examination was made of background variables.

### *Procedure*

Observations were conducted in Liverpool city centre (mainly in bars and food courts). People were covertly observed from a distance of 5–20 m. Individuals were selected if their face was visible to the observer and if they were interacting in a stable social group. A group was considered stable when all individuals remained together during the sampling period. Group size varied between 2 and 8 individuals with an average of 2.87 ( $SD = 1.20$ ). Interactions with passers-by were not recorded. All occurrences of the behaviours described below were sampled during focal observations performed on one individual of the group (Altmann, 1974). The duration of samples varied from 15 to 30 min, according to the time that individuals spent in the place. The average duration of a sample was 22.7 min ( $SD = 5.93$ ). Data covered a total of 80.36 h of observation.

### *Behaviours*

Smiles were classified in two types: spontaneous and deliberate (see also Mehu & Dunbar, 2008). The spontaneous smile was similar to the Duchenne smile described by Ekman & Friesen (1982), i.e., it had to be symmetric and involve muscle activity in the eye region. The deliberate smile category included all other types of smiles, and those 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 deliberate. Laughter was categorised in two types: spontaneous and deliberate laughter (Keltner & Bonnano, 1997). A spontaneous laugh was merely an event of laughter accompanied by a spontaneous smile whereas a deliberate laugh did not include spontaneous smiling. The target of smiling and laughter was recorded whenever it could be determined.

### *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). Unfortunately, deliberate laughter did not represent a sizeable enough class of behaviour to allow statistical testing. Effect sizes ( $d$ , Cohen, 1969) were computed using 'Effect Size Generator 2.3' (Deville, 2004).

The analysis concerning the direction of smiling and laughter was performed on a subset of 45 people (23 men, 22 women) interacting in mixed-sex groups. These people were selected on the basis that they were interacting in groups where they had the opportunity to direct their smiles and laughs at either a man or a woman. For each individual, the proportion of smiles and laughs directed at men or women was calculated out of the total frequency 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 were to receive equal amounts of smiles and laughs, the proportion of displays directed at either sex should not differ significantly from the availability of both sexes in the group. The number of individuals was counted for which the proportion of smiles and laughs were directed (i) more often at a men than a women (more than 60% directed to men and less than 40% directed to women), (ii) more often at a women than a men (more than 60% directed to women and less than 40% directed to men) and (iii) equally often at 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.

### **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. Laughter and the different types of smiles will be analysed separately.

*The sexual advertisement hypothesis*

The first prediction of the 'sexual advertisement' 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 between same-sex and mixed-sex groups (spontaneous smiles:  $t = 1.68$ ,  $p = 0.09$ ; deliberate smiles:  $t = 0.32$ ,  $p = 0.75$ ). This indicates that both types of smiles were displayed at similar rates in same-sex (spontaneous smiles:  $M = 0.56$ ,  $SD = 0.49$ ; deliberate smiles:  $M = 0.20$ ,  $SD = 0.18$ ) and mixed-sex groups (spontaneous smiles:  $M = 0.70$ ,  $SD = 0.55$ ; deliberate smiles:  $M = 0.20$ ,  $SD = 0.17$ ).

Because sex composition of groups was expected to influence laughter in a different way in men and women, data were analysed separately for each sex. Interestingly, female but not male laughter was significantly affected by the sex composition of groups (Table 1). Women laughed significantly more often when they were interacting in mixed-sex groups than when they were interacting in same-sex groups (Figure 1).

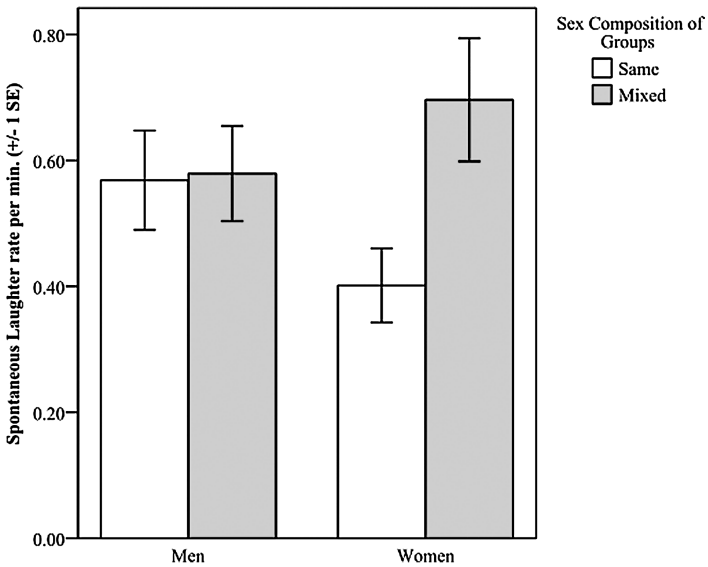
The sexual advertisement hypothesis also made predictions about the effect of age, sex, and age composition of groups on the frequency of affiliative behaviours displayed in mating contexts. A  $2 \times 2 \times 2$  univariate analysis of variance conducted in mixed-sex groups, with sex, age of focal,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

Although sex alone had no impact on smiling (spontaneous smiles:  $F_{1,111} = 0.07$ ,  $p = 0.79$ ; deliberate smiles:  $F_{1,111} = 0.79$ ,  $p = 0.37$ ) or laughter,  $F_{1,111} = 0.48$ ,  $p = 0.48$ , there was a significant interaction between age and sex on laughter rates  $F_{1,115} = 3.75$ ,  $p = 0.05$ . Student *t*-tests

**Table 1.** Mean rates per minute (and standard deviations) for spontaneous laughter displayed by men and women in same-sex and mixed-sex groups.

	Same-sex ( $N = 93$ )	Mixed-sex ( $N = 119$ )	<i>t</i>	<i>d</i>
Men	0.57 (0.49)	0.58 (0.62)	0.81	0.02
Women	0.40 (0.43)	0.70 (0.70)	2.29*	0.51

\*  $p < 0.05$ , independent sample *t*-test.



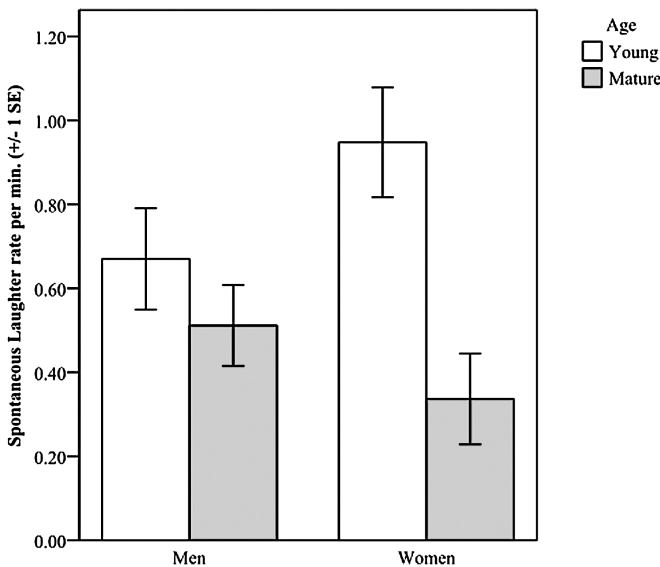
**Figure 1.** Effect of sex composition of groups on spontaneous laughter in men and women.

**Table 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.

	Young ( <i>N</i> = 59)	Mature ( <i>N</i> = 60)	<i>F</i> <sub>1,115</sub>	<i>d</i>
Spontaneous smile	0.88 (0.59)	0.52 (0.43)	9.06**	0.68
Deliberate smile	0.24 (0.17)	0.17 (0.17)	8.57**	0.42
Spontaneous laughter	0.81 (0.69)	0.45 (0.57)	9.39**	0.57

\*\* *p* < 0.005.

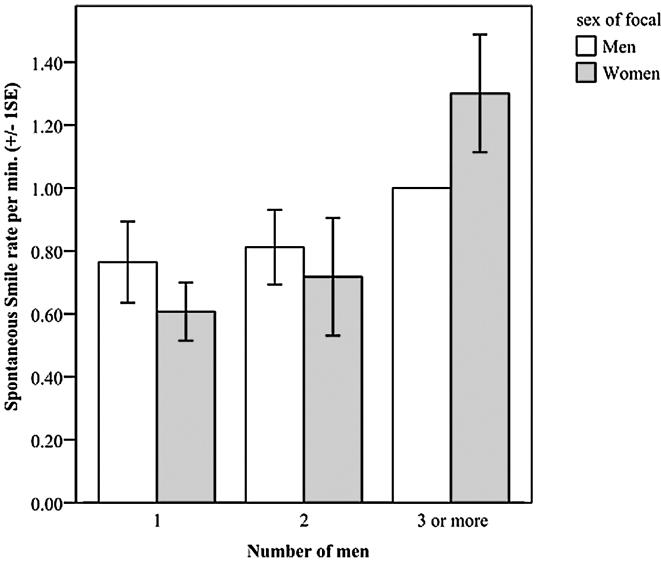
were conducted to interpret this interaction. It appeared that the age difference observed for laughter rates depended on the sex of individuals and was present in women but not men. In mixed-sex groups, laughter was displayed at significantly higher rates by young women (*M* = 0.95, *SD* = 0.72, *N* = 30) than by mature women (*M* = 0.34, *SD* = 0.49, *N* = 21), *t* = 3.56, *p* = 0.001, *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* = 0.20 (Figure 2).



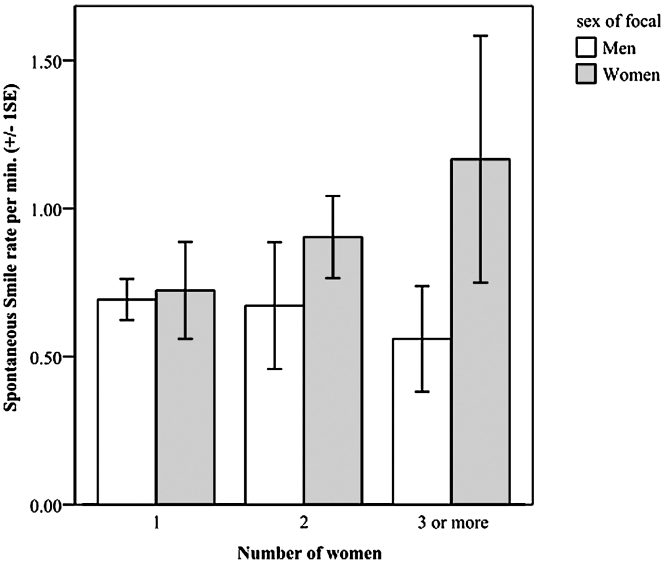
**Figure 2.** Effect of age on spontaneous laughter (mean rate per min.) displayed by men and women interacting in mixed-sex groups. Young, <35 years old; mature, >35 years old.

The sexual advertisement 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 men and women on smiling and laughter rates. The analysis revealed 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 3). On the other hand, women's spontaneous smiling was positively affected by the number of men (Figure 4) while it remained unaffected by the number of women. Interestingly, this pattern was reversed for deliberate 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 3).

Still in the context of sexual advertisement, smiling and laughter rates were expected to vary with the sex ratio. In men, smiling was not affected by the sex ratio whereas laughter was positively influenced by the proportion of men present in the group (independently of the effect of group size). In women, spontaneous smiling and laughter were both positively affected by



**Figure 3.** Effect of the presence of men on spontaneous smiles (mean rate per min).



**Figure 4.** Effect of the presence of women on spontaneous smiles (mean rate per min).

**Table 3.** 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.

Mixed-sex groups	$F$	$R^2_{\text{adj}}$	$df$	Predictors	$B$	$SE\ B$	$\beta$	$t$
Men								
Spont. smiles	2.11	0.06	67	(constant)	0.78	0.10		7.58**
				n. men	0.11	0.05	0.26	2.04*
Deliberate smiles	0.67	-0.01	67					
Spont. laughter	9.23**	0.11	67	(constant)	0.56	0.05		10.19**
				n. men	0.17	0.06	0.35	3.04**
Women								
Spont. smiles	6.74**	0.10	50	(constant)	0.50	0.11		4.56**
				n. men	0.16	0.06	0.35	2.60**
Deliberate smiles	9.40**	0.14	50	(constant)	0.36	0.03		12.41**
				n. women	0.07	0.02	0.40	3.07**
Spont. laughter	8.92**	0.24	50	(constant)	0.30	0.12		2.55*
				n. men	0.19	0.07	0.35	2.76**
				n. women	0.14	0.06	0.30	2.34*

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

the proportion of men. Finally, the sex ratio had no impact on deliberate smile rates displayed by men and women (Table 4).

### *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 deliberate smiles (Table 5). Young women showed more spontaneous smiles and laughs than mature women. In men, there was a main effect of age on deliberate smiles, indicating that young individuals displayed more deliberate smiles than mature ones.

In addition, there was a significant interaction age  $\times$  age composition of groups on men's deliberate smiles,  $F_{1,102} = 10.25$ ,  $p < 0.005$ . Further analyses showed that in mixed-age groups, young men displayed higher

**Table 4.** Summary of regression analyses addressing the impact of the sex ratio on affiliative behaviours (rate per min) displayed by men ( $N = 106$ ) and women ( $N = 106$ ).

Mixed-sex groups	$F$	$R^2_{\text{adj}}$	$df$	Predictors	$B$	SE $B$	$\beta$	$t$
Men								
Spont. smiles	2.76	0.02	105					
Deliberate smiles	0.16	-0.01	105					
Spont. laughter	4.63*	0.034	105	(constant)	0.46	0.11		4.03**
				sex ratio	0.33	0.15	0.21	2.15*
Women								
Spont. smiles	8.01**	0.06	105	(constant)	0.63	0.50		12.72**
				sex ratio	0.39	0.14	0.27	2.83**
Deliberate smiles	1.07	0.001	105					
Spont. laughter	8.68**	0.07	105	(constant)	0.57	0.06		9.97**
				sex ratio	0.46	0.16	0.28	2.95**

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

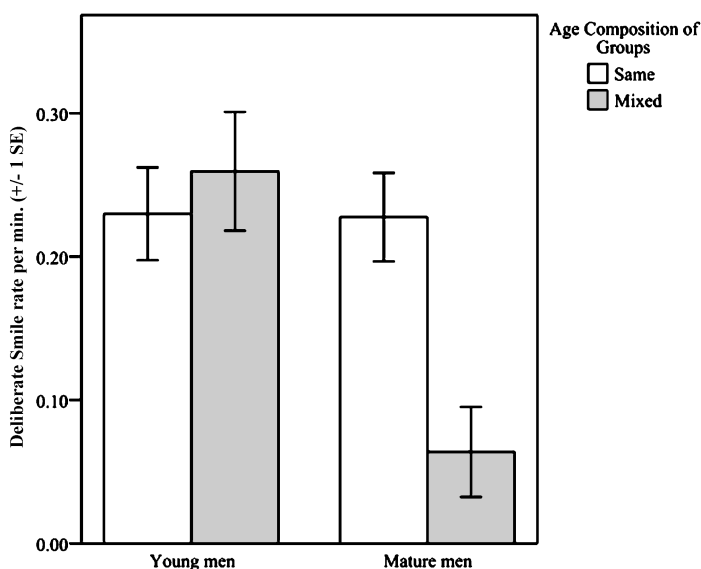
**Table 5.** Mean rates per min (and standard deviations) for affiliative behaviours displayed by young (<35 years old) and mature (>35 years old) men and women.

	Young ( $N = 49$ )	Mature ( $N = 57$ )	$F_{1,102}$	$d$
Men				
Spontaneous smile	0.81 (0.58)	0.58 (0.43)	2.82*	0.46
Deliberate smile	0.24 (0.19)	0.19 (0.20)	10.18***	0.22
Spontaneous laughter	0.66 (0.62)	0.50 (0.53)	0.72	0.28
Women				
Spontaneous smile	0.73 (0.57)	0.42 (0.44)	6.66**	0.61
Deliberate smile	0.22 (0.17)	0.17 (0.12)	1.76	0.42
Spontaneous laughter	0.70 (0.63)	0.36 (0.48)	9.04***	0.62

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

rates of deliberate smiles ( $M = 0.26$ ,  $SD = 0.13$ ,  $N = 10$ ) than mature men ( $M = 0.06$ ,  $SD = 0.11$ ,  $N = 12$ ),  $t = 3.83$ ,  $p = 0.001$ ,  $d = 1.63$ . In addition, mature men showed significantly fewer deliberate smiles when observed with younger people ( $M = 0.06$ ,  $SD = 0.11$ ,  $N = 12$ ) than when observed with people of their own age class ( $M = 0.23$ ,  $SD = 0.20$ ,





**Figure 5.** Effect of age composition of groups on deliberate smile (rate per min) in young (<35 years old) and mature (>35 years old) men.

**Table 6.** Mean rates per min (and standard deviation) of affiliative behaviours displayed by men and women.

	Men ( <i>N</i> = 106)	Women ( <i>N</i> = 106)	<i>t</i>	<i>d</i>
Spontaneous smile	0.69 (0.51)	0.59 (0.54)	1.73	0.19
Deliberate 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

*t*-values are non-significant.

*N* = 45),  $t = 3.72$ ,  $p = 0.001$ ,  $d = 0.97$ . These results are illustrated in Figure 5.

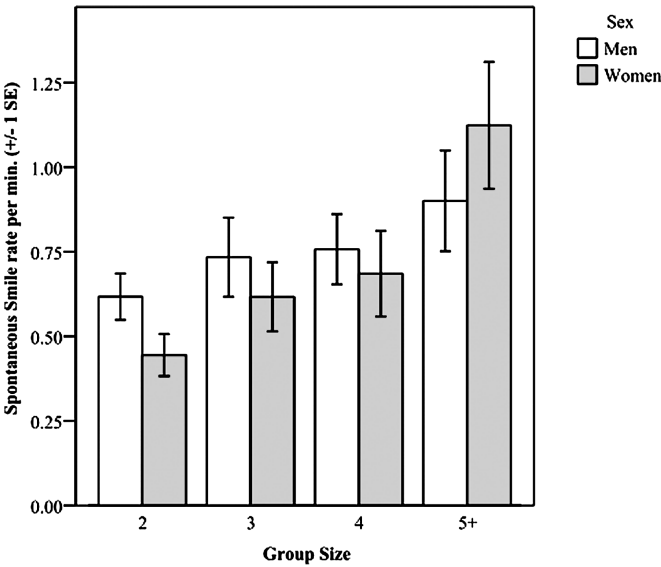
Overall, there was no sex difference in the frequencies of affiliative behaviours, indicating that men and women smiled and laughed at similar rates (Table 6).

It was also postulated that larger group sizes would lead to more competition and, therefore, positively affect smiling and laughter rates. A linear regression showed that group size had a strong and positive impact on the frequency of smiling and laughter in men and women, with the exception of men's deliberate smile rate (Table 7). Overall, the more people were interact-

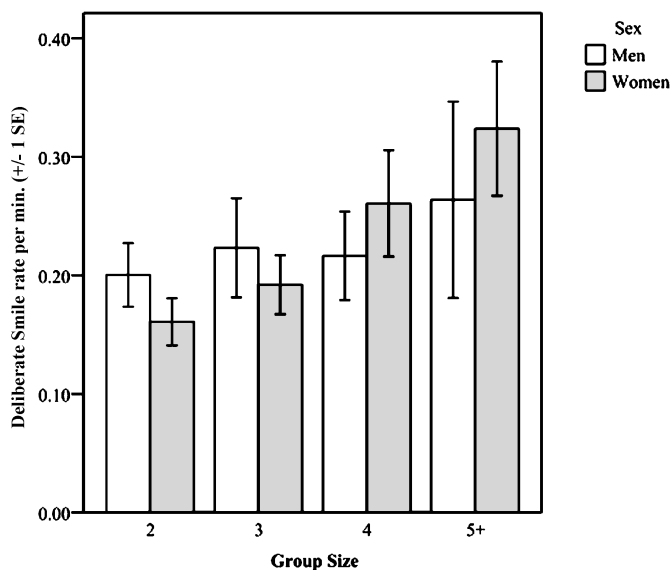
**Table 7.** Summary of regression analyses on affiliative behaviours (rate per min) displayed by men and women.

Mixed-sex groups	<i>F</i>	<i>R</i> <sup>2</sup> <sub>adj</sub>	<i>df</i>	Predictors	<i>B</i>	<i>SE B</i>	$\beta$	<i>t</i>
Men								
Spont. smiles	4.10*	0.03	105	(constant)	0.60	0.08		7.25**
				group size	0.05	0.03	0.19	2.02*
Deliberate smiles	1.22	0.002	105					
Spont. laughter	5.35*	0.04	105	(constant)	0.48	0.09		5.44**
				group size	0.07	0.03	0.22	2.31*
Women								
Spont. smiles	16.56**	0.13	105	(constant)	0.34	0.09		3.95**
				group size	0.11	0.03	0.37	4.07**
Deliberate smiles	12.34**	0.10	105	(constant)	0.24	0.05		4.96**
				group size	0.05	0.02	0.33	3.51**
Spont. laughter	29.91**	0.22	105	(constant)	0.14	0.09		1.48
				group size	0.16	0.03	0.47	5.47**

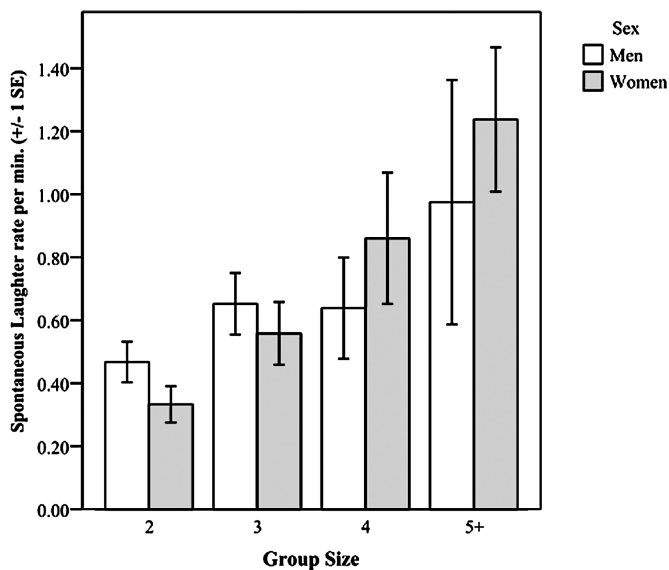
Predictor is overall group size. \**p* < 0.05, \*\**p* < 0.01.



**Figure 6.** Effect of group size on spontaneous smiles (mean rate per min) in men and women.



**Figure 7.** Effect of group size on deliberate smiles (mean rate per min) in men and women.



**Figure 8.** Effect of group size on spontaneous laughter (mean rate per min) in men and women.

ing, the more they were smiling and laughing. In addition, the effect of group size was much larger for women than for men, probably due to the fact that men’s behaviour was unaffected by the number of women (Table 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 and showed no effect of sex composition (with the exception of women laughter). On the other hand, there was a main effect of age composition of groups on the frequency of men’s spontaneous smiling and laughter, whereas the effect was marginally significant for deliberate smiling (Table 8). Men displayed significantly higher rates of spontaneous smiles and laughs (and to some extent deliberate smiles) when interacting with people of their own age class, whereas women appeared to smile and laugh equally often in same-age and mixed-age groups.

*Targets of smiling and laughter*

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

**Table 8.** Mean rates per min (and standard deviations) for affiliative behaviours displayed by men and women according to the age composition of groups.

	Same-age	Mixed-age	$F_{1,102}$	$d$
Men				
Spontaneous smile	0.74 (0.54)	0.50 (0.36)	4.54**	0.52
Deliberate smile	0.23 (0.20)	0.15 (0.15)	3.10*	0.42
Spontaneous laughter	0.60 (0.54)	0.47 (0.70)	3.94**	0.21
Women				
Spontaneous smile	0.65 (0.58)	0.47 (0.43)	2.13	0.34
Deliberate smile	0.20 (0.16)	0.18 (0.15)	0.29	0.15
Spontaneous laughter	0.58 (0.61)	0.47 (0.56)	1.58	0.19

Men: same-age,  $N = 84$ ; mixed-age,  $N = 22$ . Women: same-age,  $N = 69$ ; mixed-age,  $N = 37$ . \* $p < 0.1$ , \*\* $p < 0.05$ .

**Table 9.** Number of groups in which individuals directed their smiles/laughs <sup>(a)</sup>to men more than women, <sup>(b)</sup>to women more than men and <sup>(c)</sup>equally often to men and women.

	Sex	$\sigma^{\circ} > \phi^{\circ(a)}$	$\phi^{\circ} > \sigma^{\circ(b)}$	$\sigma^{\circ} = \phi^{\circ(c)}$	$\chi^2$
Spontaneous smile	Male	13 (6)	7 (7)	3 (10)	13.06**
	Female	9 (7)	12 (5)	1 (10)	18.47**
Deliberate smile	Male	11 (6)	6 (7)	6 (10)	5.91*
	Female	9 (7)	12 (5)	1 (10)	18.47**
Spontaneous laughter	Male	14 (6)	6 (7)	3 (10)	15.71**
	Female	9 (7)	7 (5)	6 (10)	2.97

The expected values based on the availability of each sex in the groups are shown in parentheses, these are the number of groups in which <sup>(a)</sup>men were more numerous than women, <sup>(b)</sup>women were more numerous than men and <sup>(c)</sup>men were as many as women. \* $p < 0.05$ , \*\* $p < 0.001$ , men ( $N = 23$ ), women ( $N = 22$ ).

men and women differed between interacting groups, the expected values were calculated according to the proportion of men and women available in these groups (for details on that analysis see Method). The analysis revealed that smiling and laughter were not randomly directed to men and women (Table 9). Both types of smiles were 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.

## Discussion

The present study showed that frequencies of smiling and laughter vary with diverse aspects of the social environment. The size of interaction groups had the most significant impact on smiling and laughter, with rates increasing in line with party size. In addition, people's age 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. These results will be interpreted in light of the three hypotheses presented in the introduction: the sexual advertisement hypothesis, the competition hypothesis, and the cooperation hypothesis.

*The sexual advertisement hypothesis*

The sexual advertisement 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 men and women. Moreover in men, smiling and laughter were unrelated to the number and the proportion of women present in the group, while one would expect sexual signals to increase with the proportion of opposite-sex individuals. It is, therefore, unlikely that smiling and laughter are central components of men's courtship strategies.

On the other hand, results relative to women's laughter could be compatible with the sexual advertisement 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 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, our results strongly indicate that laughter could be part of women's courtship repertoire.

A limitation of this study was that we could not specify the number of individuals involved in joke telling. This information might be useful to interpret the different effect of group size on men and women. It could be that the presence of women in a group encourages men to tell more jokes, which could, in turn, increase laughter in women. The proposal that humour evolved as a sexually selected sign of creativity (Miller, 2000) implies that men should make more attempts at humour when women are around. Interestingly, Sanford & Eder (1984) observed that the proportion of 'memorized' jokes was particularly high in newly formed mixed-sex adolescent groups. It was unclear, however, whether boys were telling more of these jokes than girls. Dunbar and colleagues (1997) showed that men's topics of conversation can be strongly influenced by the sex of the audience, with men displaying their erudition and knowledge in the presence of women. Moreover, women tend to listen more rather than speak as the number of men in the group increases (Dunbar et al., 1995), indicating that women could leave

the conversational space open to allow competition between potential partners. Further research is needed to investigate whether men's production of humour increases in the presence of women and to see how selective women are in their laugh responses to men's discourses (humorous or not).

Another prediction of the sexual advertisement hypothesis was that smiling and laughter would be preferentially directed to members of the opposite sex. 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 sexual advertisement 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. With the exception of women's laughter, the results relevant to the direction of affiliative behaviours did not support the sexual advertisement hypothesis.

The last element to consider in respect to the sexual advertisement hypothesis is the effect of age on smiling and laughter rates. If smiling and laughter inform on the reproductive potential of individuals, cues advertising such potential should 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. Interestingly, there was an interaction effect between age and sex on laughter displayed in mixed-sex groups, showing that younger women laughed more than mature ones while men laughed at similar rates regardless of age. This strengthens the assumption that female laughter could be relevant to courtship.

### *The competition hypothesis*

One 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. Because mixed-age groups were assumed to have larger hierarchical disparities, it was predicted that smiling (and eventually laughter) would be higher in these groups as opposed to same-age groups. Data did not support this prediction. On the contrary, smiling and laughter rates were highest when people were observed interacting in same-age groups, the effect being stronger in men than in women.

Nonetheless, men's — but not women's — deliberate 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 men displayed significantly more deliberate smiles than mature men when interacting in mixed-age groups suggests that deliberate smiles in men could be interpreted as a submissive display. Age being a rather indirect measure of status, this effect could be stronger in situations where status relationships are clearly emphasised.

Still in the context of social competition, it was postulated that age could affect female smiling and laughter for the same reason as it could in the context of sexual advertisement. 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. This assumption was supported by the data. Moreover 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. Nevertheless, 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 (assuming that the men present in the group are equally attractive to the women). 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.

Nevertheless, the positive relationship between women's smiling and the proportion of men could be explained by the fact that women tend to reduce competitive efforts towards male opponents (for a review, see Weisfeld, 1986), an attitude that could be translated in increased rates of smiling. Although plausible, this explanation is not compatible with the observed trend that women mainly direct their smiles to other women when interacting in mixed-sex groups. A possible explanation could be that women's attempts at forming coalitions with other women was stimulated by the presence of men and resulted in higher rates of smiling toward other women. Female coalitions to buffer the deleterious effect of male aggression has been frequently observed in other primate species (Harcourt, 1992; White, 1992; Parish, 1996; Newton-Fisher, 2006).



Another prediction of the competition hypothesis was that frequencies of smiling and laughter should rise along with party size because of increased 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 women than in men, as the variance explained by party size was 3% (spontaneous smiles) and 4% (laughter) for men, against 13%, 10% and 22% for women's spontaneous smiles, deliberate smiles, and laughter, respectively. This difference is probably due to the fact that men's affiliative displays increased with the number of men but was unaffected by the number of women, whereas women's smiling and laughter were influenced by the number of both men and women.

The observed pattern in men could fit 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 smiles and laughs to other men rather than to women. Although this seems to support the competition hypothesis, it was predicted that the proportion rather than the number of same-sex individuals should affect smiling and laughter rates. This was not the case for men smiling, as both types of smiles were unaffected by the sex ratio. Male laughter, on the other hand, was positively related to the sex ratio, indicating that laughter in men could occur in the context of social competition.

### *The cooperation hypothesis*

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 men's — but not women's — laughter. As far as the direction of smiles (and men's laughter) is concerned, the cooperation hypothesis is partly supported.

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 men but not for women. 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 smiling and laughter 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. Although people tend to have more contacts with friends at a younger age (Due et al., 1999), 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.

Another way to explore the connection between smiling, age, and the maintenance of social relationships is through their joint connection with extraversion, a personality trait that represents people's social inclinations. On the one hand, extroverts show increased rates of smiling (Ruch, 1994) and smiling faces are usually perceived as being more sociable and extroverts (Reis et al., 1990), even more so when smiling is emotion-based (Mehu et al., 2007). On the other hand, there is also a connection between extraversion and social network size, with extroverts having larger networks. Interestingly, the positive relationship between extraversion and network size is far from being universal but could essentially depend on age (Roberts et al., 2007). Besides, extraversion is negatively associated with age (McCrae et al., 1999; Roberts et al., 2007), and this could be reflected in the frequency of smiling people display when interacting in small groups. Consequently, young people could smile more as a result of being more extrovert, and that association could possibly lead to larger network size.

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 observed in smiling and laughter rates supports this prediction, even though this result is at

odds with most studies on smiling. LaFrance et al. (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 study did not find 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 indeed 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 that meta-analysis were conducted in university environments that generally provide 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 a greater compliance in experimental settings.

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 number of same-sex individuals. As mentioned above, 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. This suggests that effects of social facilitation on laughter (Chapman & Wright, 1976; Freedman & Perlick, 1979) could depend on the age composition of the group and on sex. Note that our study could not really address social facilitation effects, since observations were performed on one individual at a time. Therefore, it was not possible to check whether the focal's laughter was affected by other people's laughter. Nevertheless, 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 men.

In that respect, the impact of group size on laughter is compatible with the idea that people are eager to show they understand jokes made by others (Alexander, 1986), assuming that there are more joke tellers in larger groups. The effect of the number of men on men's laughter supports both the competition and cooperation hypotheses. Given that men tend to use more aggressive types of humour (Martin et al., 2003) and that they are particularly inclined to appreciate 'hostile wit' (O'Connell, 1960), a failure to laugh

in a male group would be like admitting one did not 'get' the joke, which could lead to a loss of status and eventually to exclusion from a coalition. It follows that men could be more prone to laugh in the presence of other men to avoid being ostracized by agonistic forms of humour. Future research should investigate the influence of social variables on the production of particular types of humour, as well as sex differences in the impact of men and women on reactions to humour.

Unfortunately, the lack of information about group dynamics made it difficult to clearly distinguish between the social competition and the cooperation hypotheses. Nonetheless, 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 could extend to the formation and maintenance of friendship.

The present study does not preclude that proximate mechanisms like those studied in psychological experiments do actually regulate the effect of social variables on smiling and laughter. This paper suggests that mechanisms like emotional contagion (Hatfield, 1994), social facilitation (Chapman & Wright, 1976), crowding effect (Freedman & Perlick, 1979), or peer pressure (Brown et al., 1982) could be put in a larger framework that takes into account the ultimate function of smiling and laughter. Despite the limitations inherent to observational studies conducted in natural settings, we would like to emphasize that the phenomena observed in experimental research could be nicely complemented by functional explanations like mate choice, social competition, and cooperation.

The take home message of this paper is that smiling and laughter might be more important in the regulation of intra-sexual relationships than in sexual advertisement (perhaps with the exception of female laughter). Moreover, the present data underlined the importance to distinguish between different types of smiles. In that respect, the differentiation between spontaneous and deliberate smiles might be functionally relevant: while deliberate smiles could be used in the regulation of hierarchical relationships, spontaneous smiles could have evolved to cement relationships between peers, possibly through emotional involvement.

## Acknowledgements

We would like to thank Anne-Charlotte Wegria for support during the study. Thanks should also go to John Archer, Mike Speed, Glen Weisfeld and an anonymous reviewer for valuable comments on an earlier version of this manuscript.

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