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The social facilitation of eating: Why does the mere presence of others cause an increase in energy intake?

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Abstract

There is strong evidence that people eat more when eating with friends and family, relative to when eating alone. This is known as the 'social facilitation of eating'. In this review, we discuss several gaps in the current scientific understanding of this phenomenon, and in doing so, highlight important areas for future research. In particular, we discuss the need for research to establish the longer-term consequences of social eating on energy balance and weight gain, and to examine whether people are aware of social facilitation effects on their own food intake. We also suggest that future research should aim to establish individual and contextual factors that moderate the social facilitation of eating (e.g. sex/gender), and it should clarify *how* eating socially causes people to eat more. Finally, we propose a novel evolutionary framework in which we suggest that the social facilitation of eating reflects a behavioural strategy that optimises the evolutionary fitness of individuals who share a common food resource.

Key words: Social facilitation of eating; Social influences; Eating behaviour; Evolution

Our food choices are strongly influenced by social factors. Research has highlighted the robust tendency for people to adjust their food intake to align with perceived eating norms, and to convey positive impressions of themselves to other people [1,2]. One particularly powerful effect is the tendency for people to eat more when eating with friends and family, relative to when eating alone. Known as the 'social facilitation of eating', the augmentation of food intake in the presence of co-eaters has also been observed in nonhuman animals including chickens, pigs, fish, rats, and primates [3–6]. Yet despite its pervasiveness, little is known about *when* and *why* the presence of other people facilitates intake. The current paper is not intended to be an exhaustive review of the literature on the social facilitation of intake (for recent reviews see [7,8]). Rather, we first provide an overview of the existing evidence for the social facilitation of eating and then identify important areas for future research. We also put forward a novel framework in which we argue that the social facilitation of eating evolved as a behavioural strategy which ensures that individuals procure maximum personal resources while sharing food with other group members. The review will be relevant to social psychologists with an interest in the social determinants of food intake from a theoretical perspective, and to health psychologists and clinicians who are seeking to develop healthy eating strategies.

1. An overview of the evidence for the social facilitation of eating

Some of the earliest evidence for the social facilitation of eating in humans was derived from a series of food-diary studies conducted by John de Castro [9,10]. In these studies, participants recorded everything that they ate and who they ate with, for seven consecutive days. Subsequent analyses of food-diary entries showed that participants ate significantly larger meals when they ate with other people, relative to when they ate alone. Notably, evidence for the social facilitation of eating was obtained across all types of meal (breakfast, lunch, dinner, and snacks), for meals consumed during weekdays and weekends, and for meals eaten with and without alcohol [11,12]. These findings are important because they suggest that the social facilitation of eating is not simply an artefact caused by a tendency to eat larger meals at particular social occasions (e.g., family gatherings and/or weekend celebratory events). Food-diary studies also demonstrated a non-linear 'social correlation', in which meal size was positively associated with the number of people present at a meal [13], though this has not been consistently demonstrated throughout the wider literature (see [8]).

Other research examining food intake within real-world settings has provided further support for the social facilitation of eating. One recent study used an Ecological Momentary Assessment (EMA) method in which participants recorded the presence of social cues (i.e. other people eating) every time they ate a snack and at randomly timed prompts throughout the day [14]. Schuz et al. [14] found that snack intake was significantly predicted by the presence of other people eating. Support for social facilitation effects on eating has also been obtained using researcher-observational methods, in which subjects were covertly observed eating in cafeterias and restaurants, when alone or with other people. Findings from these studies corroborate evidence from self-report research; subjects eating socially ate more, or purchased higher calorie meals, than those eating alone [15,16]. Taken together, findings from self-report and researcher-observational studies provide strong support for the tendency for people to eat more at social meals, relative to lone meals, consumed within real-world settings.

Findings from experimental research, in which the presence or absence of other people was deliberately manipulated, provide evidence for the causal effect of social eating on food intake. Using a pseudo-experimental approach, Redd and de Castro [17] instructed participants to consume all of their meals 'alone', 'with other people' or 'as they normally would' across five consecutive days. Participants recorded everything that they ate during each 5-day phase. Analyses of food diaries showed that participants ate more when they were instructed to eat with other people, relative to when they were instructed to eat alone. Evidence for the social facilitation of eating has also been obtained from experimental research in which food intake was assessed when participants ate alone and with friends within laboratory settings (e.g. [18]). These findings build upon evidence from real-world studies by suggesting that, relative to eating alone, eating socially *causes* people to eat larger amounts. In a recent meta-analytic review, we found that eating with friends and family has a large effect on food intake, and the size of this effect is greater than the effect of portion-size (i.e. the tendency for people to eat more when provided with larger, relative to smaller, portions) [8].

2. Addressing gaps in knowledge

Findings from both experimental and nonexperimental research provide strong evidence that eating with familiar others causes people to eat more than they would alone. However, social facilitation of eating remains a poorly understood phenomenon. In this section, we highlight

several gaps in the literature and discuss areas for future research. Specifically, we address the following questions: 1) What are the longer-term consequences of social eating on food intake and weight gain? 2) Are people aware of social facilitation effects on their own food intake? 3) Do people eat *more* when eating socially, or *less* when eating alone? 4) To what extent is social facilitation of eating moderated by individual characteristics and contextual factors (e.g., sex/gender, weight status)? 5) What mechanisms underlie the social facilitation of eating? 6) Does social facilitation of eating serve an ultimate evolutionary purpose?

2.1. What are the longer-term consequences of social eating for intake and weight gain?

There is currently a lack of research examining how the presence of other people affects food intake and weight gain over the longer-term. Previous studies have focused on establishing social facilitation effects on eating during a single meal, and so it remains unclear whether such effects persist across multiple meal occasions. Evidence from the wider eating behaviour literature suggests that people are generally poor at compensating for changes in calorie intake [19]. For example, participants who were deprived of breakfast did not compensate for this energy deficit by consuming additional calories at lunch [20]. Conversely, participants who were provided with 133% *more* calories than their usual intake across two weeks, did not eat less than usual across subsequent weeks [21]. In a review of 199 similar studies, Levitsky et al. [19] found that imposed caloric deficits or surfeits were never fully compensated for during subsequent meals. This failure to show complete compensation also extends to any case where meal size is increased. For example, large portions encourage the consumption of larger meals, and when this happens subsequent food intake is largely unaffected [22,23].

Drawing upon evidence that people do not fully compensate for additional intake, a likely outcome is that eating socially leads to a chronic increase in calorie intake, and thereby promotes weight gain. Future research should address the following questions: 1) Do social facilitation effects on eating persist across multiple meal occasions? 2) Do people compensate for additional calories consumed during social meals by eating less at later meal occasions? 3) To what extent does eating socially contribute to weight gain over time? Establishing the longer-term effects of social eating on calorie intake and weight is especially important given that the majority of people eat with other people at least a few times a week [24]. Research examining the longer-term effects of social eating on calorie intake has

important implications for dietary interventions. Notably, because eating socially likely confers advantages to people's overall wellbeing and feelings of social cohesion [25], avoiding social meals altogether is perhaps not advisable. However, in order to offset the effect of social eating on overall calorie intake, one strategy may be to encourage people to deliberately eat smaller meals either before or after a social meal.

2.2. Are people aware of social facilitation effects on intake?

The extent to which people are aware of social facilitation effects on eating remains unclear. Several studies indicate that people underestimate the extent to which their food intake is influenced by the intake of others [26]. Instead, they tend to attribute their food intake to internal factors, such as hunger or 'liking' for the food, even though these factors correlate weakly with actual food intake [26]. However, rather than reflecting a genuine lack of awareness, findings from subsequent research suggest that people may be reluctant to admit that their own food intake is influenced by social factors. Evidence for the 'motivated denial' of social influences on intake was demonstrated across two studies in which participants watched a video of someone else (study 1) or themselves (study 2) eating with another person [27]. Participants successfully recognised the role of social influences (i.e. mimicking) when they watched someone else eat (study 1), but not when they watched themselves eat (study 2).

The question of whether or not people are aware of, and acknowledge, social facilitation effects has several important implications. For example, if people fail to acknowledge the role of social influences on food intake, they may be unlikely to implement strategies aimed at minimising social facilitation effects on food intake. Furthermore, underestimating the role of social influences on food intake may lead people to more frequently expose themselves to situations in which they are likely to eat more than they intend. If social eating contributes to overeating over the longer-term, then a further concern is that misattributing overeating and weight gain to internal factors (such as a lack of self-control), rather than to external/social factors, may cause people to experience self-blame for overeating and increase internalised weight stigma amongst people with overweight. This is especially problematic given the abundance of research which has demonstrated associations between internalised weight stigma and disordered patterns of eating (e.g. [28]). Future research should therefore examine a) the extent to which people are aware of social

facilitation effects on their own food intake, and b) whether raising awareness of the social facilitation of eating can help to mitigate feelings of self-blame for overeating.

2.3. Do people eat *more* when eating socially, or *less* when eating alone?

Across the social facilitation literature, eating alone is assumed as the baseline to be compared with eating socially. However, one can also make the reverse comparison and conclude that, relative to eating socially, people tend to limit their food intake when eating alone. Notably, surveys conducted within American and European populations show that meals tend to be regarded as social occasions, and that the majority of people rarely eat alone [29–31]. Meals eaten alone are perceived as functional, rather than enjoyable, and people report eating faster and choosing more convenient, less tasty food when alone [32]. Furthermore, eating alone can be viewed negatively, and some people avoid eating alone in public places (e.g. restaurants) due to concerns about being judged unfavourably by others [32]. Taken together, these findings support the possibility that eating alone is an impoverished experience associated with reduced food intake. Indeed, it has been argued that social *facilitation* effects on eating may be best conceptualised as 'solitary *inhibition* effects' [31]. However, this alternative perspective is challenged by evidence that people eat more as a function of group size, even when lone eaters are not included within the correlation (i.e. the 'social correlation', [9,13]). In other words, social facilitation of eating is observed even when the comparison is between two people eating together versus three or four people eating together, and so it is not simply the case that people in groups eat more than solo eaters: bigger groups eat more than smaller groups. Nonetheless, the extent to which group size influences food intake remains unclear, and several studies have failed to uncover any evidence for the social correlation (e.g. [33–35]). Future research should therefore aim to clarify the extent to which food intake is truly '*facilitated'* during social meals.

2.4. Is social facilitation of eating moderated by individual characteristics and contextual factors?

In a recent meta-analysis, we found an overall significant social facilitation effect on food intake [8]. Notably, however, several studies have failed to demonstrate social facilitation of eating [33,36–39]. It may therefore be the case that social facilitation effects on eating are attenuated within certain contexts. In this section, we consider the individual and/or contextual factors that may moderate social facilitation effects on intake, such as the

degree to which co-eaters are familiar with each other, individuals' weight status and gender, dietary restraint, and the type of food available.

Co-eater familiarity

In our meta-analysis of evidence derived from experimental research, we found that the social facilitation of eating is strongly moderated by familiarity between co-eaters [8]. Specifically, evidence for social facilitation was demonstrated across studies which had examined food intake when participants ate with *friends,* but not across studies which had examined food intake when participants ate with strangers or acquaintances. Co-eater familiarity may account for the lack of social facilitation effects observed in some research. Indeed, of the experimental studies that failed to demonstrate social facilitation of eating, *none* had examined food intake when participants ate with familiar co-eaters [36–39]. This is important because, in the real world, the vast majority of social meals are eaten with friends and family [40]. One explanation for the lack of evidence for social facilitation of eating amongst strangers is that, when people dine with unfamiliar others, food intake is inhibited by 'impression management concerns'; because people are motivated to promote positive impressions to unfamiliar people [41], when they dine with them they tend to select smaller-than-normal portions. Consistent with this reasoning, people who choose smaller meals are perceived as healthier and more physically attractive [42]. Future research should test the possibility that social facilitation of eating is attenuated when people eat with strangers due to heightened impression management concerns. Furthermore, from a methodological perspective, the moderating effect of co-eater familiarity highlights the need for research into social influences on eating to account for whether co-eaters know each other. Specifically, to gain a greater understanding of the factors that further moderate or mediate social facilitation effects on eating, it will be important for research to examine food intake amongst groups of *friends and family*.

Dietary restraint

Several studies have examined whether social facilitation of eating is moderated by dietary restraint (i.e. the tendency to purposefully limit one's food intake). It is thought that people with higher levels of dietary restraint are more susceptible to overeating in situations in which top-down cognitive controls over food intake are disrupted. Indeed, one study found that the augmentation of food intake while engaging in a distracting activity (i.e. listening to a

story) correlated positively with dietary restraint [43]. Eating socially may similarly disrupt cognitive controls over food intake, and so it is reasonable to predict that people with higher levels of dietary restraint might be more susceptible to social facilitation effects on food intake. However, contrary to this prediction, several studies have found no evidence that social facilitation of eating is moderated by dietary restraint [34,36,44]. However, Vartanian and colleagues [45] found that restrained eaters were more responsive than were unrestrained eaters when exposed to a high intake social norm: when eating with a confederate who ate a large amount, restrained eaters were more likely to model this high intake norm than were unrestrained eaters. Further research is required to clarify these findings and establish why, unlike other external influences on food intake, social facilitation of eating appears to be unaffected by dietary restraint.

Sex/Gender and weight status

There is tentative evidence that the social facilitation of eating is moderated by individual characteristics such as sex/gender and weight status. For example, self-report and researcher-observational studies indicate that social facilitation of eating is stronger in men than in women [16,46] and it may depend upon the gender composition of the group. In a researcher-observational study, Young et al. [35] found that females eating in *same*-sex groups ate more than those eating alone, but females eating in *mixed*-sex groups ate less than those eating alone. In addition, weight status may play a role; several studies report that people with overweight eat *less* when they eat socially [15,47–49], and this effect might be further moderated by the weight status of co-eaters. Notably, one study found that preadolescent girls with overweight ate less when eating with a non-overweight peer, relative to when eating with a peer who has overweight [50]. However, there has been no systematic study of the moderating effects of weight status and gender on social facilitation of eating amongst groups of *friends*, and so this remains an important area of research.

Research is also needed to establish *why* individual characteristics moderate social facilitation effects on eating. As with co-eater familiarity (discussed previously), it is likely that impression management concerns play a role in moderating social facilitation of eating amongst certain individuals. For example, research shows that people tend to associate eating smaller portions with ‘feminine’ characteristics [51], and so women might be less likely to demonstrate social facilitation of eating if they are motivated to present a feminine image to

others. Similarly, people with overweight may choose smaller portions to elicit favourable judgements from other people. This suggestion is supported by evidence that people have more favourable impressions of individuals with overweight who choose smaller, relative to larger, meals [52]. Building upon these findings, future research should explore whether any moderating effect of gender and weight status on social facilitation of eating can be explained by individuals' motivations to portray positive impressions of themselves to others. In particular, the following predictions might be explored: 1) Social facilitation of eating will be attenuated amongst females when eating with male friends, relative to when eating with female friends, 2) Social facilitation of eating will be weaker amongst people with overweight when eating with non-overweight friends, relative to when eating with friends who have overweight.

Food type

It remains unclear whether eating socially facilitates intake of all foods. Some studies show specific effects on intake of foods that are high-fat and sweet [18] and high fat and high protein [9,17,53], while others find an effect of the presence of other people on the intake of *all* macronutrients [54]. It is also unclear whether the effects of the presence of others are moderated by palatability. Apart from extending our general understanding, research of this kind has the potential to inform the development of healthy eating strategies. For example, providing healthier foods (e.g. fruits and vegetables) during social meals may be an effective strategy for helping people to improve the quality of their diets. In support of this idea, a recent study found that participants who were presented with pictures of people *sharing* healthy food, rated the food as more appealing relative to those who were shown pictures of people eating healthy food *alone* [55].

3. What are the mechanisms underlying the social facilitation of eating?

Time extension hypothesis

The mechanisms by which the presence of other people facilitates food intake are yet to be established. One idea, favoured by John de Castro [56], is that people eat more during social meals because social meals last longer than do meals eaten alone. Consistent with this 'time extension hypothesis,' positive associations have been observed between group size, food intake, and meal duration [40,57].

Notwithstanding these findings, other work has shown that a longer meal duration is neither necessary nor sufficient for social facilitation to occur [18,58]. Furthermore, the precise mechanisms by which longer meal duration facilitates food intake remain unclear.

Notably, longer meals do not necessarily imply that people spend more time *eating*; a plausible unsophisticated interpretation is that conversation tends to extend the period during which people interact with each other, which increases their interaction with food and the opportunity to eat.

Mood and appetite processes

A further possibility is that meals eaten socially are more enjoyable, and for this reason, they are consumed in larger portions. In support of this idea, positive mood states are more likely to be reported during a social eating occasion [56], and when meals co-occur with a positive mood state then they tend to be larger [53]. There is also evidence that food tastes better when eaten socially. In one study, chocolate was rated as more palatable when it was consumed with another person [59]. Future research should examine whether social facilitation of eating is mediated by effects of eating socially on people's mood and/or perceived liking for food. Notably, one self-report study found that positive mood ratings did *not* predict additional variation in food intake after controlling for group size [56][60]. However, experimental research is needed in order to clarify any causal associations (or lack thereof) between the presence of other people, meal enjoyment, and food intake, under controlled settings.

A related explanation is that eating socially impacts hunger and fullness directly. This remains to be tested, however evidence from one study suggests that food eaten socially may be less satiating than food eaten alone. Specifically, McAlpine et al. [61] found that eating socially causes a similar reduction in hunger to eating alone, even though social eating promotes a larger meal. Therefore, a promising avenue for future research might be to examine whether social eating delays the onset of satiation or otherwise impacts subsequent satiety after consuming a fixed meal.

Finally, eating socially may also affect appetite processes via distraction. Indeed, there is robust evidence that eating while engaging in a distracting activity (e.g. watching TV) attenuates feelings of fullness and sensory specific satiety, and causes people to eat more, relative to when eating without distraction (e.g.[62,63]). These findings indicate that engaging in distracting activities can increase food intake even when eating alone, however the extent to which distraction fully accounts for social facilitation effects on food intake

remains unclear. Findings from one experimental study yield partial support for the role of distraction in the social facilitation of eating. Specifically, Hetherington et al. [18] found that participants spent more time looking away from a meal, and consumed more food, when eating with a friend relative to when eating alone. However, participants also spent longer looking away from a meal when they ate with a stranger, and yet eating with a stranger did *not* facilitate food intake. On this basis, Hetherington et al. [18], concluded that the social facilitation of eating is not governed solely by cognitive distraction. Furthermore, in a recent study, we found that participants served themselves larger quantities of food *before* a social meal, relative to before a lone meal [64]. These findings suggest that people decide to eat more *prior* to a social meal, and so distraction may not be necessary to facilitate food intake during social meals.

Social norms

There is robust evidence that social norms have a strong influence on people's decisions about what and how much to eat [65]. It is therefore possible that social facilitation of eating is driven by culturally agreed norms to eat more when eating with other people. In support of this idea, Cavazza et al. [66] found that social facilitation effects on food choice were only observed in participants who scored high on a trait measure of self-monitoring (i.e. greater sensitivity to social cues and motivation to act appropriately). Drawing upon these findings, Cavazza et al. [65] suggested that participants ordered more food per capita as a function of group size in order to adhere to a shared social script to eat more than usual. The idea that social norms play a pivotal role in social facilitation of eating is further supported by findings from a study that used EMA methods to assess how the presence of other people influences snack consumption [14]. Findings from this study showed that the presence of other people eating significantly predicted snack consumption, and that this was mediated by the extent to which participants perceived eating to be 'appropriate' and 'encouraged'.

While social norms appear to play an important role in social facilitation of eating, it is unclear why people should necessarily be influenced to eat *more* rather than *less* during social meals. One possibility is that people overestimate how much other people eat during social meals, and so they increase their intake to match the perceived intake of others [7]. Alternatively, social facilitation of eating may be driven by a tendency for individuals to eat as much as the person in the group who is eating the most. It is thought that people are motivated to maximise their intake of palatable food [67], and so one way to do this could be

to eat as much as the largest eater. Another possibility is that people may be especially likely to conform to group norms to 'eat *more'* in an attempt to make others in the group feel comfortable with their own food intake. Evidence for 'altruistic indulgence' has been obtained across two studies which showed that subjects were more likely to make unhealthy food choices if their eating companion had made an unhealthy choice, relative to when their companion had made a healthy choice [68]. Furthermore, the tendency to make unhealthy food choices was mediated by participants' self-reported motivation to make their companion feel positive about their own food choices. More research is needed in order to establish why people conform to norms to 'eat more' during social meals, and whether adherence to social eating norms mediates social facilitation effects on food intake. Other fundamental questions relate to the origin or reason why social eating norms have arisen in the first place. In the next section we consider whether the effects of social norms and social eating can be explained by an evolutionary pressure to develop strategies that ensured maximum food intake in communities in which food sharing occurred routinely.

4. What is the ultimate purpose of social facilitation of eating?

To understand social facilitation of eating from an evolutionary perspective, it is useful to distinguish *ultimate* and *proximate* explanations of behaviour [69]. Ultimate explanations relate to *why* a behaviour benefits fitness, whereas proximate explanations relate to *how* that benefit is realised (proximate needs serve ultimate objectives). For example, the ultimate explanation for infant crying is that a mechanism is required for alerting the possibility of abandonment to others (abandonment increases the risk of predation, starvation, and so on). By contrast, the proximate explanation is that infants feel distress, and this then causes them to cry. Thus far we have only considered proximate explanations (e.g., a positive mood influences appetite). However, the fact that social facilitation of eating is observed across so many species [3–6] strongly suggests that it occurs for a reason. We propose that the ultimate explanation lies in a need to ensure that food intake is *maximised* in environments where food sharing is ubiquitous. As we will now explain, social facilitation of eating may have evolved as a strategy to ensure that individuals obtain maximum personal resources while sharing food with other group members.

Until relatively recently, human food sourcing was risky and required considerable effort. So why share? Why would this cultural practice develop when a food recipient gains fitness benefits while the donor incurs a cost? Because sharing has been observed across a variety of nonhuman animals, including primates [70], birds [71] and insects [72], long-term

benefits must outweigh any short-term costs. Food sharing minimises the risk of starvation [73] caused by injury or time spent nurturing children. During times of food scarcity, individual foraging successes might be variable, and so sharing also mitigates this by distributing risk across group members. And on occasions when a large animal was killed, and more meat is available than can be consumed by a single individual, it can be distributed before it spoils. Behavioural ecologists also suggest that alerting others to a food source increases overall foraging efficiency and helps to defend the food from non-clan members [74]. Furthermore, sharing yields wider benefits, by augmenting the overall fitness of the group and by enhancing social bonds [74].

While sharing food confers both group and individual benefits, individual fitness still relies on competition. Repeated selfless sharing incurs cost in terms of lost resource, which negatively impacts relative fitness. It is therefore likely that the amount eaten when eating socially reflects an interplay between the motivation to obtain maximum personal resources, and the motivation to avoid sanctions related to uncooperative behaviour while sharing food. In support of the idea of competition and personal gain, several studies show that when eating with conspecifics, human and nonhuman animals adjust their foraging to obtain maximum personal resource (e.g., [75]), and that this 'cheating' occurs, especially during times of food scarcity [76]. In the absence of complex measuring devices (e.g., balance scales) perfect equitable division may be impossible. One conspecific might be a 'risky cheater' (they accept the associated risk of ostracism) or a larger portion might even be selected by accident. In response to the prospect of inequity, and to maintain social acceptability, one simple strategy is to engage in 'vigilant sharing,' and to eat at least as much as the group member who has consumed the largest meal [77]. An emergent property of such a strategy is that the likelihood of cheating or accidental overconsumption increases with the number of people present at a meal, which might explain why a monotonic relationship is sometimes found between the effects of social facilitation of eating and group number [13]. Proximal mechanisms for social facilitation of eating (for example, enhanced meal enjoyment) would have promoted the act of food sharing and motivated individuals to consume their fair share of a meal. Our evolutionary model highlights the importance of maximising individual fitness by finding a balance between ensuring long-term social cohesion and maximising personal gain (or at least ensuring inequality does not occur). In this respect, it shares remarkable similarity with a broad literature on cooperative behaviour and inequality aversion (i.e. the

tendency to resist an unequal distribution of resources, [78]) in humans and non-human animals.

The abundance of energy-dense foods in the modern environment creates an evolutionary mismatch, and so social facilitation no longer serves an ultimate function. However, proximate mechanisms continue to guide our eating behaviour and may, in some situations, contribute to overeating [79]. Importantly, our evolutionary theory of the social facilitation of eating generates several hypotheses for future research. First, to ensure that we obtain (but do not exceed) our fair share of food, it would have been important to monitor the intake of others in the group. We might therefore predict that social facilitation of eating is mediated by the extent to which individuals monitor the intake of others. Second, because personality traits are known to predict responses to unfair outcomes [80], we might expect the same traits to moderate evidence for social facilitation of eating.

5. Conclusion

It is well-established that both humans and nonhuman animals eat more when eating socially relative to when eating alone. However, there remain several gaps in the scientific understanding of the social facilitation of eating. As we have discussed in this article, it is particularly important for research to establish the longer-term consequences of social eating on overall energy balance, and to examine whether people are *aware* of the effects of social facilitation on their food intake. Research is also required to clarify the individual and contextual factors that moderate the social facilitation of eating (e.g. gender, weight status), and to identify *how* social eating drives food intake. Such research has important implications for the development of weight management strategies. Finally, we provide a novel theoretical framework for understanding the ultimate purpose of the social facilitation of eating. In particular, we suggest that the social facilitation of eating evolved as a behavioural strategy which ensures that individuals procure maximum personal resources while sharing food with other group members. Importantly, this evolutionary account of the social facilitation of eating generates several hypotheses for future research.

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References

[1] E. Robinson, J. Thomas, P. Aveyard, S. Higgs, What everyone else is eating: A systematic review and meta-analysis of the effect of informational eating norms on eating behavior, J. Acad. Nutr. Diet. 114 (2014) 414–429. https://doi.org/10.1016/j.jand.2013.11.009.

[2] L.R. Vartanian, Impression management and food intake. Current directions in research, Appetite. 86 (2015) 74–80. https://doi.org/10.1016/j.appet.2014.08.021.

[3] D.W. Rajecki, R.F. Kidd, D.A. Wilder, J. Jaeger, Social factors in the facilitation of feeding in chickens: Effects of imitation, arousal, or disinhibition?, J. Pers. Soc. Psychol. 32 (1975) 510–518. https://doi.org/10.1037/h0077065.

[4] J.C. Welty, Experiments in group behavior of fishes., Physiol. Zoölogy. 7 (1934) 85–128.

[5] K.T. Hoyenga, S. Aeschleman, Social facilitation of eating in the rat, Psychon. Sci. 14 (1969) 239. https://doi.org/10.3758/BF03332815.

[6] H.F. Harlow, H.C. Yudin, Social behavior of primates. I. Social facilitation of feeding in the monkey and its relation to attitudes of ascendance and submission., J. Comp. Psychol. 16 (1933) 171–185. https://doi.org/10.1037/h0071690.

[7] C.P. Herman, The social facilitation of eating. A review, Appetite. 86 (2015) 61–73. https://doi.org/10.1016/j.appet.2014.09.016.

[8] H.K. Ruddock, J.M. Brunstrom, L.R. Vartanian, S. Higgs, A systematic review and meta-analysis of the social facilitation of eating, Am. J. Clin. Nutr. 110 (2019) 842–861. https://doi.org/10.1093/ajcn/nqz155.

[9] J. de Castro, E. de Castro, Spontaneous meal patterns of humans : influence of the presence of other people, Am. J. Clin. Nutr. 50 (1989) 237–247. https://doi.org/10.1093/ajcn/50.2.237.

[10] J.M. de Castro, F. Bellisle, G.I.J. Feunekes, A.-M. Dalix, C. De Graaf, Culture and meal patterns: A comparison of the food intake of free-living American, Dutch, and French students, Nutr. Res. 17 (1997) 807–829. https://doi.org/10.1016/S0271-5317(97)00050-X.

[11] J.. de Castro, E.. Brewer, D.. Elmore, S. Orozco, Social Facilitation of the Spontaneous Meal Size of Humans Occurs Regardless of Time, Place, Alcohol or Snacks, Appetite. 15 (1990) 89–101.

[12] J.M. de Castro, Social facilitation of the spontaneous meal size of humans occurs on

both weekdays and weekends, Physiol. Behav. 49 (1991) 1289–1291. https://doi.org/10.1016/0031-9384(91)90365-U.

[13] J.M. de Castro, E.M. Brewer, The amount eaten in meals by humans is a power function of the number of people present, Physiol. Behav. 51 (1991) 121–125. https://doi.org/10.1016/0031-9384(92)90212-K.

[14] B. Schuz, T. Papadakis, S.G. Ferguson, Situation-specific social norms as mediators of social influence on snacking, Heal. Psychol. 37 (2018) 153–159. https://doi.org/10.1037/hea0000568.

[15] D.S. Krantz, A Naturalistic Study of Social Influences on Meal Size among Moderately Obese and Nonobese Subjects, Psychosomat. 4 (1979) 19–27.

[16] R.C. Klesges, D. Bartsch, J.D. Norwood, D. Kautzrnan, S. Haugrud, The effects of selected social and environmental variables on the eating behavior of adults in the natural environment, Int. J. Eat. Disord. 3 (1984) 35–41. https://doi.org/10.1002/1098-108X(198422)3:4<35::AID-EAT2260030405>3.0.CO;2-7.

[17] M. Redd, J.M. de Castro, Social facilitation of eating: Effects of social instruction on food intake, Physiol. Behav. 52 (1992) 749–754. https://doi.org/10.1016/0031-9384(92)90409-U.

[18] M.M. Hetherington, A.S. Anderson, G.N.M. Norton, L. Newson, Situational effects on meal intake: A comparison of eating alone and eating with others, Physiol. Behav. 88 (2006) 498–505. https://doi.org/10.1016/j.physbeh.2006.04.025.

[19] D.A. Levitsky, A. Sewall, Y. Zhong, L. Barre, S. Shoen, N. Agaronnik, J.L. LeClair, W. Zhuo, C. Pacanowski, Quantifying the imprecision of energy intake of humans to compensate for imposed energetic errors: A challenge to the physiological control of human food intake, Appetite. 133 (2019) 337–343. https://doi.org/10.1016/j.appet.2018.11.017.

[20] A. Martin, S. Normand, M. Sothier, J. Peyrat, C. Louche-Pelissier, M. Laville, Is advice for breakfast consumption justified? Results from a short-term dietary and metabolic experiment in young healthy men, Br. J. Nutr. 84 (2000) 337–344. https://doi.org/DOI: 10.1017/S0007114500001616.

[21] D.A. Levitsky, The non-regulation of food intake in humans: Hope for reversing the epidemic of obesity, Physiol. Behav. 86 (2005) 623–632. https://doi.org/10.1016/j.physbeh.2005.08.053.

[22] B.J. Rolls, L.S. Roe, J.S. Meengs, The effect of large portion sizes on energy intake is sustained for 11 days, Obesity. 15 (2007) 1535–1543.

https://doi.org/10.1038/oby.2007.182.

[23] B.J. Rolls, L.S. Roe, J.S. Meengs, Larger portion sizes lead to a sustained increase in energy intake over 2 days, J. Am. Diet. Assoc. 106 (2006) 543–549. https://doi.org/10.1016/j.jada.2006.01.014.

[24] YouGov, BBC Good Food Survey, (2014). https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/83for68scz/YG-Archive-140721-bbc.pdf (accessed December 22, 2020).

[25] R.I.M. Dunbar, Breaking Bread: the Functions of Social Eating, Adapt. Hum. Behav. Physiol. 3 (2017) 198–211. https://doi.org/10.1007/s40750-017-0061-4.

[26] L.R. Vartanian, C.P. Herman, B. Wansink, Are We Aware of the External Factors That Influence Our Food Intake?, Heal. Psychol. 27 (2008) 533–538. https://doi.org/10.1037/0278-6133.27.5.533.

[27] S. Spanos, L.R. Vartanian, C.P. Herman, J. Polivy, Failure to report social influences on food intake: Lack of awareness or motivated denial?, Heal. Psychol. 33 (2014) 1487–1494. https://doi.org/10.1037/hea0000008.

[28] R.L. Pearl, R.M. Puhl, Weight bias internalization and health: a systematic review, Obes. Rev. 19 (2018) 1141–1163. https://doi.org/10.1111/obr.12701.

[29] I. Mestdag, Disappearance of the traditional meal: Temporal, social and spatial destructuration, Appetite. 45 (2005) 62–74. https://doi.org/https://doi.org/10.1016/j.appet.2005.03.003.

[30] J. Sobal, M.K. Nelson, Commensal eating patterns: A community study, Appetite. 41 (2003) 181–190. https://doi.org/10.1016/S0195-6663(03)00078-3.

[31] P. Pliner, R. Bell, A table for one: the pain and pleasure of eating alone, Woodhead Publishing Limited, Cambridge, 2009. https://doi.org/10.1016/B978-1-84569-403-6.50009-X.

[32] G. Danesi, Pleasures and stress of eating alone and eating together among French and German young adults, Menu, J. Food Hosp. Res. Res. 1 (2012) 77–91.

[33] E. Brindal, C. Wilson, P. Mohr, G. Wittert, Eating in groups: Do multiple social influences affect intake in a fast-food restaurant?, J. Health Psychol. 20 (2015) 483–489. https://doi.org/10.1177/1359105315576607.

[34] V.I. Clendenen, C.P. Herman, J. Polivy, Social Facilitation of Eating Among Friends and Strangers, Appetite. 23 (1994) 1–13. https://doi.org/10.1006/APPE.1994.1030.

[35] M.E. Young, M. Mizzau, N.T. Mai, A. Sirisegaram, M. Wilson, Food for thought. What you eat depends on your sex and eating companions, Appetite. 53 (2009) 268–

271. https://doi.org/10.1016/j.appet.2009.07.021.

[36] F. Bellisle, A.M. Dalix, G. Airinei, S. Hercberg, S. Péneau, Influence of dietary restraint and environmental factors on meal size in normal-weight women. A laboratory study, Appetite. 53 (2009) 309–313. https://doi.org/10.1016/j.appet.2009.07.006.

[37] A. Mekhmoukh, D. Chapelot, F. Bellisle, Influence of environmental factors on meal intake in overweight and normal-weight male adolescents. A laboratory study, Appetite. 59 (2012) 90–95. https://doi.org/10.1016/j.appet.2012.03.021.

[38] S. Péneau, A. Mekhmoukh, D. Chapelot, A.M. Dalix, G. Airinei, S. Hercberg, F. Bellisle, Influence of environmental factors on food intake and choice of beverage during meals in teenagers: A laboratory study, Br. J. Nutr. 102 (2009) 1854–1859. https://doi.org/10.1017/S0007114509991280.

[39] P. Pliner, R. Bell, E.S. Hirsch, M. Kinchla, Meal duration mediates the effect of "social facilitation" on eating in humans, Appetite. 46 (2006) 189–198. https://doi.org/10.1016/j.appet.2005.12.003.

[40] G.I.J. Feunekes, C. de Graaf, W.A. van Staveren, Social facilitation of food intake is mediated by meal duration, Physiol. Behav. 58 (1995) 551–558. https://doi.org/10.1016/0031-9384(95)00087-Y.

[41] D.M. Tice, J.L. Butler, M.B. Muraven, A.M. Stillwell, When modesty prevails: Differential favorability of self-presentation to friends and strangers., J. Pers. Soc. Psychol. 69 (1995) 1120–1138. https://doi.org/10.1037/0022-3514.69.6.1120.

[42] L.R. Vartanian, C.P. Herman, J. Polivy, Consumption stereotypes and impression management: How you are what you eat, Appetite. 48 (2007) 265–277. https://doi.org/https://doi.org/10.1016/j.appet.2006.10.008.

[43] F. Bellisle, A.-M. Dalix, Cognitive restraint can be offset by distraction, leading to increased meal intake in women, Am. J. Clin. Nutr. 74 (2001) 197–200. https://doi.org/10.1093/ajcn/74.2.197.

[44] J.M. De Castro, The relationship of cognitive restraint to the spontaneous food and fluid intake of free-living humans, Physiol. Behav. 57 (1995) 287–295. https://doi.org/10.1016/0031-9384(94)00229-X.

[45] L.R. Vartanian, C.P. Herman, J. Polivy, Modeling of food intake among restrained and unrestrained eaters, Appetite. 155 (2020) 104811. https://doi.org/https://doi.org/10.1016/j.appet.2020.104811.

[46] F. Bellisle, A.M. Dalix, J.M. De Castro, Eating patterns in French subjects studied by

the “weekly food diary” method, Appetite. 32 (1999) 46–52. https://doi.org/10.1006/appe.1998.0195.

[47] M.K. Maykovich, Social constraints in eating patterns among the obese and overweight, Soc. Probl. 25 (1977) 453–460. https://doi.org/10.3868/s050-004-015-0003-8.

[48] S.J. Salvy, J.S. Coelho, E. Kieffer, L.H. Epstein, Effects of social contexts on overweight and normal-weight children’s food intake, Physiol. Behav. 92 (2007) 840–846. https://doi.org/10.1016/j.physbeh.2007.06.014.

[49] B. Schüz, S. Revell, A.P. Hills, N. Schüz, S.G. Ferguson, Higher BMI is associated with stronger effects of social cues on everyday snacking behaviour, Appetite. 114 (2017) 1–5. https://doi.org/10.1016/j.appet.2017.03.012.

[50] S.J. Salvy, N. Romero, R. Paluch, L.H. Epstein, Peer influence on pre-adolescent girls’ snack intake: Effects of weight status, Appetite. 49 (2007) 177–182. https://doi.org/10.1016/j.appet.2007.01.011.

[51] S. Chaiken, P. Pliner, Women, but not Men, Are What They Eat: The Effect of Meal Size and Gender on Perceived Femininity and Masculinity, Personal. Soc. Psychol. Bull. 13 (1987) 166–176. https://doi.org/10.1177/0146167287132003.

[52] Y. Martins, P. Pliner, C. Lee, The effect of meal size and body size on individuals’ impressions of males and females, Eat. Behav. 5 (2004) 117–132. https://doi.org/10.1016/j.eatbeh.2004.01.008.

[53] K.A. Patel, D.G. Schlundt, Impact of moods and social context on eating behavior, Appetite. 36 (2001) 111–118. https://doi.org/10.1006/appe.2000.0385.

[54] N. Stroebele, J.M. de Castro, Influence of physiological and subjective arousal on food intake in humans, Nutrition. 22 (2006) 996–1004. https://doi.org/10.1016/j.nut.2006.07.003.

[55] K. Maldoy, C.J.S. De Backer, K. Poels, The pleasure of sharing: Can social context make healthy food more appealing?, Psychol. Mark. 38 (2021) 359–370. https://doi.org/10.1002/mar.21396.

[56] J.M. De Castro, Social Facilitation of Duration and Size But Not Rate of the Spontaneous Meal Intake of Humans, Physiol. Behav. 47 (1990) 1129–1135.

[57] V.I. Clendenen, C.P. Herman, J. Polivy, Social facilitation of eating among friends and strangers, Appetite. 23 (1994) 1–13.

[58] J.C. Lumeng, K.H. Hillman, Eating in larger groups increases food consumption, Arch. Dis. Child. 92 (2007) 384–387. https://doi.org/10.1136/adc.2006.103259.

[59] E.J. Boothby, M.S. Clark, J.A. Bargh, Shared Experiences Are Amplified, Psychol. Sci. 25 (2014) 2209–2216. https://doi.org/10.1177/0956797614551162.

[60] J.M. de Castro, Social facilitation of duration and size but not rate of the spontaneous meal intake of humans, Physiol. Behav. 47 (1990) 1129–1135. https://doi.org/10.1016/0031-9384(90)90363-9.

[61] S.J. McAlpine, J. Harper, M.E.T. McMurdo, C. Bolton-Smith, M.M. Hetherington, Nutritional supplementation in older adults: Pleasantness, preference and selection of sip-feeds, Br. J. Health Psychol. 8 (2003) 57–66. https://doi.org/10.1348/135910703762879200.

[62] F. Bellisle, A.M. Dalix, G. Slama, Non food-related environmental stimuli induce increased meal intake in healthy women: comparison of television viewing versus listening to a recorded story in laboratory settings, Appetite. 43 (2004) 175–180. https://doi.org/https://doi.org/10.1016/j.appet.2004.04.004.

[63] J.M. Brunstrom, G.L. Mitchell, Effects of distraction on the development of satiety, Br. J. Nutr. 96 (2006) 761–769. https://doi.org/DOI: 10.1079/BJN20061880.

[64] H.K. Ruddock, E.V. Long, J.M. Brunstrom, L.R. Vartanian, S. Higgs, People serve themselves larger portions before a social meal., Sci. Rep. In press (2021).

[65] S. Higgs, Social norms and their influence on eating behaviours, Appetite. 86 (2015) 38–44. https://doi.org/10.1016/j.appet.2014.10.021.

[66] N. Cavazza, A.R. Graziani, M. Guidetti, Looking for the “right” amount to eat at the restaurant: Social influence effects when ordering, Soc. Influ. 6 (2011) 274–290. https://doi.org/10.1080/15534510.2011.632130.

[67] C.P. Herman, D.A. Roth, J. Polivy, Effects of the presence of others on food intake: a normative interpretation, Psychol. Bull. 129 (2003) 873—886. https://doi.org/10.1037/0033-2909.129.6.873.

[68] Y. Yi, J.C. Lee, S. Kim, Altruistic indulgence: people voluntarily consume high-calorie foods to make other people feel comfortable and pleasant, Soc. Influ. 13 (2018) 223–239. https://doi.org/10.1080/15534510.2018.1546616.

[69] T.C. Scott-Phillips, T.E. Dickins, S.A. West, Evolutionary Theory and the Ultimate–Proximate Distinction in the Human Behavioral Sciences, Perspect. Psychol. Sci. 6 (2011) 38–47. https://doi.org/10.1177/1745691610393528.

[70] A.R. Nettelbeck, Observations on food sharing in the wild lar gibbons (Hylobates lar), Folia Primatol. 69 (1998) 386–391.

[71] C.S. Evans, P. Marler, Food calling and audience effects in male chickens, Gallus

gallus: their relationships to food availability, courtship and social facilitation, Anim. Behav. 47 (1994) 1159–1170. https://doi.org/https://doi.org/10.1006/anbe.1994.1154.

[72] K. Vahed, The function of nuptial feeding in insects: a review of empirical studies, Biol. Rev. 73 (1998) 43–78. https://doi.org/https://doi.org/10.1111/j.1469-185X.1997.tb00025.x.

[73] H. Kaplan, M. Gurven, K. Hill, A.M. Hurtado, The natural history of human food sharing and cooperation: a review and a new multi-individual approach to the negotiation of norms, Moral Sentim. Mater. Interes. Found. Coop. Econ. Life. 6 (2005) 75–113.

[74] J.R. Stevens, I.C. Gilby, A conceptual framework for nonkin food sharing: Timing and currency of benefits, Anim. Behav. 67 (2004) 603–614. https://doi.org/10.1016/j.anbehav.2003.04.012.

[75] Y. Ogura, T. Masamoto, T. Kameda, Mere presence of co-eater automatically shifts foraging tactics toward 'Fast and Easy'' food in humans,' R. Soc. Open Sci. 7 (2020) 200044. https://doi.org/10.1098/rsos.200044.

[76] L. Samuni, A. Preis, T. Deschner, C. Crockford, R.M. Wittig, Reward of labor coordination and hunting success in wild chimpanzees, Commun. Biol. 1 (2018) 138. https://doi.org/10.1038/s42003-018-0142-3.

[77] D. Erdal, A. Whiten, On human egalitarianism: An evolutionary product of Machiavellian status escalation?, Curr. Anthropol. 35 (1994) 175–183. https://doi.org/10.1086/204255.

[78] E. Fehr, K.M. Schmidt, A Theory of Fairness, Competition, and Cooperation, Q. J. Econ. 114 (1999) 817–868. https://doi.org/10.1162/003355399556151.

[79] J.M. Brunstrom, B.K. Cheon, Do humans still forage in an obesogenic environment? Mechanisms and implications for weight maintenance, Physiol. Behav. 193 (2018) 261–267. https://doi.org/10.1016/j.physbeh.2018.02.038.

[80] H. Brandstätter, M. Königstein, Personality influences on ultimatum bargaining decisions, Eur. J. Pers. 15 (2001) S53–S70. https://doi.org/10.1002/per.424.