

A systematic review and meta-analysis of the social facilitation of eating

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ABSTRACT

Background: Research suggests that people tend to eat more when eating with other people, compared with when they eat alone, and this is known as the social facilitation of eating. However, little is known about when and why this phenomenon occurs.

Objectives: This review aimed to quantify the evidence for social facilitation of eating and identify moderating factors and underlying mechanisms.

Methods: We systematically reviewed studies that used experimental and nonexperimental approaches to examine food intake/food choice as a function of the number of co-eaters. The following databases were searched during April 2019: PsychInfo, Embase, Medline, and Social Sciences Citation Index. Studies that used naturalistic techniques were narratively synthesized, and meta-analyses were conducted to synthesize results from experimental studies.

Results: We reviewed 42 studies. We found strong evidence that people select and eat more when eating with friends, compared with when they eat alone [$Z = 5.32$; $P < 0.001$; standardized mean difference (SMD) = 0.76; 95% CI: 0.48, 1.03]. The meta-analysis revealed no evidence for social facilitation across studies that had examined food intake when participants ate alone or with strangers/acquaintances ($Z = 1.32$; $P = 0.19$; SMD = 0.21, 95% CI: -0.10, 0.51). There was some evidence that the social facilitation of eating is moderated by gender, weight status, and food type. However, this evidence was limited by a lack of experimental research examining the moderating effect of these factors on the social facilitation of eating among friends. In 2 studies, there was evidence that the effect of the social context on eating may be partly mediated by longer meal durations and the perceived appropriateness of eating.

Conclusions: Findings suggest that eating with others increases food intake relative to eating alone, and this is moderated by the familiarity of co-eaters. The review identifies potential mechanisms for the social facilitation of eating and highlights the need for further research to establish mediating factors. Finally, we propose a new theoretical framework in which we suggest that the social facilitation of eating has evolved as an efficient evolutionary adaptation. *Am J Clin Nutr* 2019;110:842–861.

Keywords: social facilitation, social influences, food intake, food choice, meta-analysis

Introduction

Social factors are important in determining what and how much we eat (1). The tendency for people to eat more when eating in groups than when eating alone is known as the social facilitation of eating. Social facilitation effects have been well documented across a range of cognitive and physical tasks, and it is thought that the presence of other people potentiates dominant responses (2). In the presence of food, the dominant response is to eat. De Castro and colleagues (3) describe social facilitation as “the most important and all pervasive influence on eating yet identified” (p. 100). Given that 77% of adults in the United Kingdom eat as a household at least once a week (4), and that a substantial proportion of people’s meals are eaten with others (5), it is important to establish when and why social contexts facilitate food intake.

Research on the social facilitation of eating examines eating behaviors when participants eat in larger or smaller social groups (or alone). Social facilitation effects on eating have been examined using both experimental methods, in which group sizes are experimentally manipulated, and nonexperimental methods, in which eating behaviors are examined within real-world contexts. Nonexperimental research into the social facilitation of eating has gathered data using self-reports (i.e.,

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Supplemental Figure 1 is available from the “Supplementary data” link in the online posting of the article and from the same link in the online table of contents at <https://academic.oup.com/ajcn/>.

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food diaries/ecological momentary assessment) and researcher-observation methods. Research examining the social facilitation of eating has typically used naive volunteers who are free to eat as much or as little as they like, and comparisons are made between the eating behaviors (e.g., food intake) of participants eating alone and the eating behaviors of participants eating with other people. Some social facilitation studies have also examined associations between the number of people present at a meal and amounts consumed (this is known as the social correlation).

There have been 2 recent narrative reviews of the social facilitation of eating (6, 7). These reviews concluded that the social facilitation of eating is a robust phenomenon, yet the underlying cause(s) remain unclear. A systematic review and meta-analysis of the literature on the social facilitation of eating would build on existing narrative reviews to quantify the size of the effect of social facilitation and formally identify moderators and mediators. In this paper, we present results from a systematic review and meta-analysis that aimed to assess quantitative evidence for the social facilitation of eating and to identify moderating factors. We include both naturalistic and experimental studies that examined food intake or choice as a function of group size in human participants. We also draw conclusions on the current evidence regarding the mechanisms underlying the social facilitation of eating and, in doing so, we identify gaps in the existing knowledge base and provide directions for future research.

Methods

Eligibility criteria

We included studies with human volunteers of any age that had used naturalistic or experimental approaches to examine food intake or food choice as a function of the presence of co-eaters. Experimental studies were excluded if both the group size and environmental context were manipulated simultaneously (e.g., examining food intake when participants ate alone in a laboratory context and with others in a cafeteria setting) (8–10). Because social facilitation effects on eating are thought to occur when eating in the presence of other co-eaters (i.e., not with passive observers) (11), we excluded studies which examined food intake when participants ate in the presence of others who were not eating (e.g., 12). Only studies published in English were included.

Search strategy

The search strategy was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (13). Relevant studies were identified by searching the following electronic databases during April 2019: PsychInfo, Embase, Medline, and Social Sciences Citation Index. We searched for papers that contained the term “social facilitation,” in addition to either “food choice,” “food intake,” “food selection,” or “eating.” Search limiters included human subjects and studies published in English. These electronic searches were supplemented with a manual search of the citation lists of relevant articles. Independently, 2 reviewers screened all search results for their

eligibility by examining titles and abstracts. No disagreements were reported. The full texts of potentially relevant papers were then screened.

Quality assessment

Quality checks for randomized controlled trials and epidemiological studies were not relevant, as these approaches were not used in any of the studies identified in the current review. We recorded whether attempts to disguise the study aims were reported (in both experimental and diary/ecological momentary assessment studies), and whether demand awareness was assessed and reported. Funnel plots were inspected to check for publication biases among experimental studies that were included in the meta-analysis (**Supplemental Figure 1**).

Data extraction

For each study, we extracted the following information: 1) sample characteristics, 2) design, 3) primary outcome measures, 4) main findings, and 5) whether any moderators or mechanisms were tested or identified. If data required for the meta-analysis (e.g., means and SDs) were missing, lead authors on the manuscripts were contacted and asked to provide the necessary information. Missing SD values were calculated based on the observed mean difference between conditions and the corresponding *P* value (14).

Data synthesis

An inverse variance meta-analysis was used to combine the results from experimental studies that had compared food intake when participants ate alone and with other people. Revman (Cochrane) version 5.3.5. was used to calculate the weighted, standardized mean difference (SMD) between the alone and social eating conditions for each study. A positive SMD indicates that people ate more when eating socially, compared with when they ate alone. CIs (95%) and I^2 values were also provided to assess statistical heterogeneity. Where high levels of heterogeneity were observed, we calculated the random effects weighted mean difference. Subgroup analyses were conducted to compare findings from studies that had examined social facilitation when participants ate with their friends with studies that had examined eating with groups of strangers or acquaintances. SMDs were calculated separately for each subgroup. Some studies compared social facilitation effects across different populations (e.g., in overweight and nonoverweight participants); these provided more than 1 comparison to the analysis. For studies that compared food intake when participants ate in larger versus smaller groups, mean values were collapsed across all groups.

Owing to the limited number of experimental studies, those that examined the effect of social facilitation on other aspects of eating (e.g., food choice) were narratively synthesized. Similarly, studies that did not include an eat-alone condition, or which used nonexperimental methods, were unsuitable for inclusion in the meta-analysis and were, therefore, narratively synthesized.

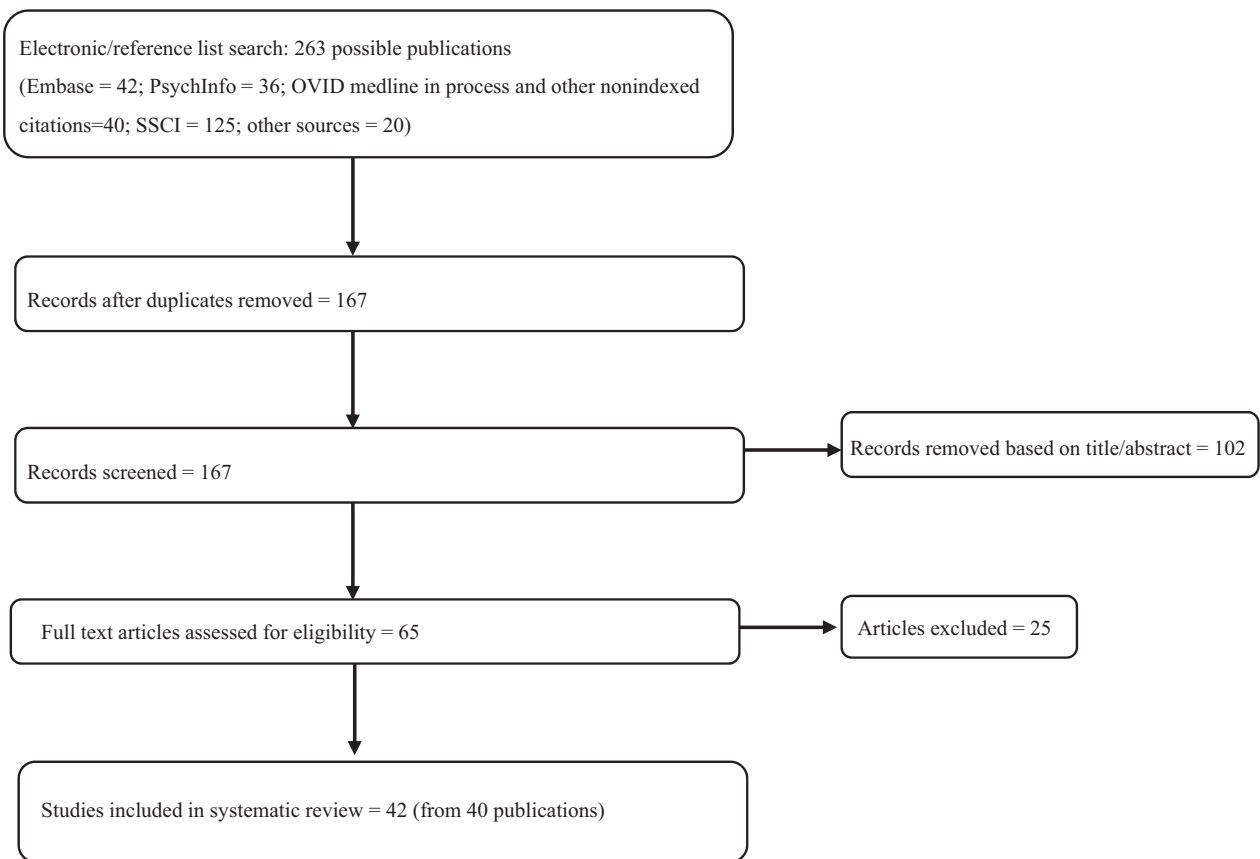


FIGURE 1 PRISMA search and inclusion flow chart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; SSCI, Social Sciences Citation Index.

Results

Search results

Initial searches identified 263 publications, of which 65 were fully assessed. A further 25 articles were excluded on the following basis: no variation in group size ($n = 16$); did not measure food intake or choice when eating with other people ($n = 5$); did not compare group vs. alone under similar conditions ($n = 3$); and repeated findings from another study ($n = 1$). There were 2 articles (15, 16) that each reported 2 separate studies that met the eligibility criteria, and so 42 studies were included from 40 publications (Figure 1). Some studies did not meet the inclusion criteria in the systematic review/meta-analysis, but nonetheless provided insight into the moderators and mechanisms involved in social facilitation of eating (12, 17–22). We therefore included these in our wider discussion of the literature.

Study type

Studies were classified based on the methodology used: 14 used an experimental approach and 28 used nonexperimental methods. Of the nonexperimental studies, 6 studies recorded data using naturalistic observation methods and 22 used diary or ecological momentary assessment methods. Of the studies that used diary/ecological momentary assessment methods, 13

reported original data and 9 used reanalyzed data sets from previous diary studies. To avoid duplication of data across reanalyzed and original diary studies, reanalyzed data sets were not included when discussing the strength of the effect of social facilitation. Instead, findings from these studies were used only to provide insight into moderators and mechanisms of the social facilitation of eating. An overview of the included studies is presented in Table 1.

Overview of study designs and participants

Experimental research.

Across the 14 studies that used experimental approaches, data were collected from a total of 1004 participants. With the exception of 1 study (23), all studies reported the mean age of participants. Social facilitation was examined across a range of age groups, including children (mean age range: 4–8 years) (24–26); adolescents aged 15–16 years (27, 28); older adults (mean age: 68 years) (29); and adults (mean age range: 22–41 years) (15, 30–35). The majority ($n = 10$) of studies recruited both men and women, 2 recruited women only (30, 31), and 2 recruited men only (27, 32). There were 4 studies that did not report participants' weight status (15, 23, 24, 35), 3 that specifically recruited roughly equal numbers of overweight and nonoverweight participants (25, 27, 32), and 1 study that restricted recruitment to nonoverweight participants (26). Across

TABLE 1 Study information and methods of selected studies grouped by study design¹

Authors, year	<i>n</i>	Participant age, y	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
Experimental studies								
Bellisle et al., 2009 (30)	40	Mean = 26	Mean = 22	F	1) Eating alone; 2) Eating in groups of 3 (unacquainted); 3) Listening to detective story; 4) Watching TV (no food cues); and 5) Watching TV (food adverts)	Amount (g) eaten of main meal and dessert (casserole and fruit sherberts)	No	No moderating effect of dietary restraint
Berry et al., 1985 (23)	126	Not reported	Not reported	M (n = 65) + F (n = 61)	1) Eating alone + 1 flavor ice cream; 2) Eating alone + 3 flavors of ice cream; 3) Eating with others + 1 flavor ice cream; and 4) Eating with others + 3 flavors of ice cream	Amount eaten (ice cream)	Yes	SF observed in both men and women given 1 flavor of ice cream. SF only observed for women, not men, in participants given 3 flavors of ice cream.
Cavazza et al., 2011 (Study 2) (15)	255	Mean = 30	Not reported	M (n = 142) + F (n = 113)	1) 1 other person; 2) 2 other people; 3) 3 other people; and 4) 4 other people	Number of dishes selected	Yes	SF only observed in people who scored high on a measure of self-monitoring.
Clendenen et al., 1994 (31)	120	Mean = 22	Mean = 21	F	1) Alone; 2) In pairs (friends); 3) In pairs (strangers); 4) In groups of 4 (friends); and 5) in groups of 4 (strangers)	Amount eaten (deli foods and cookies)	Yes	No moderating effect of familiarity on effect of group size on food intake (excluding "alone" condition). No moderating effect of dietary restraint. Those eating in pairs and 4s ate for longer than those eating alone.
Edelman et al., 1986 (32)	53 (46 used in analysis)	Mean = 34	25 OW (> 15% variance from height/weight norms; 21 NW (< 10% variance from height/weight norms)	M	1) Alone; and 2) Eating in groups of 4 or 5	Amount eaten (lasagna)	Yes	Moderating effect of weight status did not reach significance.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, <i>y</i>	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
Hetherington et al., 2006 (33)	37	Mean = 28	Mean = 24	M (<i>n</i> = 21) + F (<i>n</i> = 16)	1) Solo eating; 2) Eating while watching TV; 3) Eating with strangers (2 others); and 4) Eating with friends (2 others)	Amount eaten (buffet lunch). Meal duration. Amount of time spent attending to and looking away from food.	Yes	Familiarity: SF observed when participants ate with friends, not strangers. Food type: SF specifically for high-fat/sweet food. Eating with friends and strangers significantly increased meal duration and time spent looking away from the food, relative to eating alone.
Lumeng & Hillman, 2007 (24)	54	Mean = 4	Not reported	M (<i>n</i> = 37) + F (<i>n</i> = 17)	1) Eating in small groups (3 children); and 2) Eating in large groups (9 children)	Amount eaten (crackers)	Yes, controlling for meal duration	No difference in meal duration between large and small groups.
McAlpine et al., 2003 (29)	21	Mean = 68	Mean = 27	M (<i>n</i> = 2) + F (<i>n</i> = 19)	1) Eating alone; and 2) Eating with 2 friends	Amount consumed (weight and energy intake) from snacks high-energy nutritional supplements (sip feed, crisps, cereal bar, chocolate, beer, crackers)	Yes	Changes in hunger, fullness, and desire to eat ratings, prior to and after a meal, were similar in "alone" and "with friends" conditions.
Mekhmoukh et al., 2012 (27)	38	Mean = 16	NW mean = 21; OW mean = 29	M	1) Eating alone; 2) Eating in groups of 3; 3) Watching TV; and 4) Listening to music	Energy intake from food (casserole and chocolate brownies) and drinks (soda, water, and juice)	No	No moderating effect of weight status.
Péneau et al., 2009 (28)	29	15–16	Mean = 21	M (<i>n</i> = 14) + F (<i>n</i> = 15)	1) Watching TV; 2) Listening to music; 3) Eating alone; and 4) Eating in groups of 3	Energy intake from food (casserole and cake) and drinks (water, soda, and juice)	No	No moderating effect of gender.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, <i>y</i>	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
Pliner et al., 2006 (34)	132	Mean = 41	Mean = 26	M (n = 70) + F (n = 62)	1) Male/12 min/alone; 2) Male/36 min/alone; 3) Female/12 min/alone; 4) Female/36 min/alone; 5) Male/12 min/2 people; 6) Male/36 min/2 people; 7) Female/12 min/2 people; 8) Female/36 min/2 people; 9) Male/12 min/4 people; 10) Male/36 min/4 people; 11) Female/12 min/4 people; and 12) Female/36 min/4 people	Amount eaten (pizza and cookies)	No	No moderating effect of gender. Participants ate more in longer meals, relative to shorter meals, regardless of group size.
Redd & de Castro, 1992 (35)	30	Mean = 23	Not reported	M (n = 10) + F (n = 20)	Over 5-day periods, participants instructed to: 1) Eat as they normally would; 2) Eat exclusively alone; and 3) Eat only with others present. Participants recorded their food intake.	Self-reported food intake	Yes	Meal type: fat intake higher in normal versus alone condition. Within normal condition, fat intake was higher when participants ate with others, relative to when they ate alone. Weight status: SF observed in non-OW children, and not in OW children. No moderating effect of gender.
Salvy et al., 2007 (25)	32	Mean = 8	15 NW; 17 OW	M (n = 16) + F (n = 16)	1) OW/alone; 2) OW/in groups of 4; 3) NW/alone; and 4) NW /in groups of 4	Amount eaten (pizza)	Yes, only for non-OW participants	Weight status: SF observed in non-OW children, and not in OW children. No moderating effect of gender.
Salvy et al., 2008 (26)	44	Mean = 7	NW only	M (n = 20) + F (n = 24)	1) Alone; 2) With sibling; and 3) With unfamiliar child	Amount eaten (cookies)	Yes, only for children who ate with siblings	Familiarity: SF only observed in children eating with siblings, not strangers.
Nonexperimental: diary studies								
Bellisle et al., 1999 (36)	26	Mean = 23	Mean = 20	M (n = 10) + F (n = 16)	For 7 days, participants recorded amount eaten and the number of people present at each meal. Levels of hunger and fullness were also recorded before and after each meal.	Calories consumed at each meal (self-reported) and number of people present	Yes	Stronger correlation between meal size and number of people present in men, relative to women. The authors do not state whether this difference was significant.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, <i>y</i>	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
de Castro et al., 1990 (3)	78	Mean = 32	Not reported	M (<i>n</i> = 21) + F (<i>n</i> = 57)	Reanalyzed diary data sets	Self-reported meal size; number of people present; whether the record was a meal or snack; eaten with or without alcohol; and eaten at home, in a restaurant, or elsewhere	Yes	SF was reported across all meals (breakfast, lunch, dinner) and snacks, eaten at all locations, and consumed with and without alcohol.
de Castro, 1990 (37)	82	Mean = 32	Mean = 23	M (<i>n</i> = 23) + F (<i>n</i> = 59)	Reanalyzed diary data sets	Self-reported meal size, number of people present, meal duration, eating rate, subjective ratings of elation and anxiety	Yes	Eating rate was unrelated to number of people present. Meal duration was predicted by group size and was associated with the amount eaten. Elation ratings did not predict meal size when controlling for number of people present.
de Castro, 2002 (38)	762	Age range: 20–34 (<i>n</i> = 325); 35–49 (<i>n</i> = 292); 40–64 (<i>n</i> = 99); and 65+ (<i>n</i> = 46)	Mean = 25	M (<i>n</i> = 348) + F (<i>n</i> = 414)	Reanalyzed diary data sets	Self-reported meal size (kcal), the number of people present	Yes	Social correlation did not differ between age groups.
de Castro, 1991 (39)	315	Mean = 32	Mean = 23	M (<i>n</i> = 121) + F (<i>n</i> = 194)	Reanalyzed diary data sets	Self-reported meal size (kcal), number of people present, and whether the meal was eaten at the weekend or during the week	Yes	Social correlation greater for meals consumed at weekends, compared with weekdays.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, <i>y</i>	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
de Castro, 1994 (40)	515	Mean = 42	Mean = 25	M (<i>n</i> = 276) + F (<i>n</i> = 239)	Reanalyzed diary data sets	Self-reported meal size, number of people present, type of companion (friend, family, spouse, coworker, or other), subjective ratings of elation and anxiety	Yes	Meals eaten with family/spouse were larger and faster, and meals eaten with friends were larger and of longer duration, compared with meals eaten with others. Anxiety/elation ratings were higher in meals eaten with other people than meals eaten alone. Participant gender x companion gender interaction: women ate more when eating with men, than with women. Men unaffected by companion's gender.
de Castro, 1995 (41)	358	Mean = 44	Mean = 26	M (<i>n</i> = 201) + F (<i>n</i> = 157)	Reanalyzed diary data sets	Self-reported meal size, dietary restraint (assessed using the TFEQ)	Yes	SF was not moderated by dietary restraint.
de Castro et al., 1997 (42)	216 (26 French; 140 American; 50 Dutch)	Mean = 23	Mean = 22	M (<i>n</i> = 68) + F (<i>n</i> = 148)	For 7 days, participants recorded amount eaten, and the number of people (men and women) present at each meal. Hunger ratings were also recorded before and after each meal.	Self-reported meal size	Yes	Correlation between meal size and number of people present similar across all 3 nationalities (i.e., French, Dutch, and American).
de Castro et al., 2002 (43)	84 (56 with type 1 diabetes and 28 healthy controls)	Diabetic mean = 53; healthy mean = 49	Diabetic mean = 25; healthy mean = 23	M (<i>n</i> = 30 with diabetes; <i>n</i> = 5 controls) + F (<i>n</i> = 26 with diabetes; <i>n</i> = 23 controls)	For 7 days, participants recorded amount eaten, and the number of people (men and women) present at each meal. Mood and appetite ratings were also recorded before and after each meal, and participants rated the palatability of each meal.	Self-reported meal size	Yes	Social correlation did not differ between diabetic and control participants.
de Castro, 1997 (44)	265 twin pairs (110 identical twins; 102 fraternal, same-sex twins; 53 fraternal, mixed-sex twins)	Mean = 40	Mean = 25	M + F	Reanalyzed diary data sets. Self-report data originally collected from 110 identical twins and 102 nonidentical (same-sex) twins. An additional 53 mixed-sex twins were recruited for this study.	Self-reported meal size	Yes	Genetic influences explained 30% of the difference in regression slopes between the number of people present at a meal and meal size.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, <i>y</i>	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
de Castro & de Castro, 1989 (45)	63	Mean = 34	Not reported	M (<i>n</i> = 14) + F (<i>n</i> = 49)	For 7 days, participants recorded amount eaten, and the number of people present at each meal. Levels of hunger were also recorded prior to each meal. Reanalyzed diary data sets	Self-reported meal size	Yes	Meals eaten alone had higher proportion of carbohydrates, and lower proportion of fat, than meals eaten with other people.
de Castro & Brewer, 1991 (46)	153	Mean = 34	Not reported	M (<i>n</i> = 49) + F (<i>n</i> = 104)	Reanalyzed diary data sets	Self-reported meal size	Yes	—
de Castro & Taylor, 2008 (47)	650 (99 smokers; 551 nonsmokers)	Mean = 38	Mean = 25	M (<i>n</i> = 288) + F (<i>n</i> = 362)	Reanalyzed diary data sets	Self-reported meal size, number of people present, smoking status	Yes	SF effect stronger in smokers compared with nonsmokers.
Elmore & de Castro, 1991 (48)	52 (19 untreated bulimics; 12 recovered bulimics; 21 controls)	Untreated bulimics: mean = 22; recovered bulimics: mean = 26; normal eaters: mean = 26	Not reported	F	For 7 days, participants recorded everything that they ate and drank, and the number of people present at each meal.	Calories consumed at each meal (self-reported) and number of people present	Yes	Social correlation was stronger in healthy controls, compared with those with untreated and recovered bulimia.
Feunekes et al., 1995 (Study 1) (16)	30	Mean = 22	Mean = 22	M (<i>n</i> = 15) + F (<i>n</i> = 15)	Participants recorded food consumption, meal duration, number of others present, relationship to co-eaters, and atmosphere (sociability). Records made over 4 days.	Calories consumed at each meal (self-reported), number of people present, meal duration, and atmosphere	Yes	Social correlation only observed for meals eaten at breakfast time.
Feunekes et al., 1995 (Study 2) (16)	20	Mean = 23	Mean = 22	M (<i>n</i> = 10) + F (<i>n</i> = 10)	Participants recorded food consumed, meal duration, number of others present, atmosphere (sociability), relationship to co-eaters, and amount intended to eat (small to large amount on 10 point scale). Records made over 7 days.	Calories consumed at each meal (self-reported), number of people present, meal duration, atmosphere, amount intended to eat prior to meal occasion	Yes	Social correlation only observed for snacks. Across Studies 1 and 2, the social correlation was not moderated by external eating score. Meal duration mediated the relationship between group size and food intake.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, <i>y</i>	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
Heusel & de Castro, 1997 (49)	99 (33 underweight; 66 normal weight)	Underweight mean = 26; control group 1 = 35; control group 2 = 28	Underweight mean = 19; NW mean = 24	F	For 7 days, participants recorded everything they ate and drank, and the number of people present at each meal. They also reported the time of each meal, and their pre- and post-meal ratings of hunger, fullness, depression, and anxiety.	Calories consumed at each meal (self-reported)	Yes	No moderating effect of weight status.
Horgan et al., 2019 (50)	4156	Mean = 50 years	Not reported	M + F	For 4 days, participants recorded everything they ate and drank, as well as the time it was eaten, where it was eaten, and who they were eating with.	Calories and meat (g) consumption at each meal	Yes	—
Patel & Schlundt, 2001 (51)	78	Mean = 37	Mean = 32	F	Participants recorded everything that they ate, and whether other people were present. Participants also recorded their mood at each eating episode. Records were taken over 2 weeks.	Calories consumed at each meal (self-reported), mood, and number of people present	Yes	No interaction between mood state and social context on intake. Meals eaten socially contained more calories from fat and protein, and less calories from carbohydrates, than meals eaten alone.
Pearcey & de Castro, 1997 (52)	29	Mean = 13 months	19 infants fell between the 5th and 95th percentiles for height and weight for age	M (n = 18) + F (n = 11)	Parents recorded everything the infants ate, the number of people present and their relationships to the infant, and the beginning and end time of the eating episode.	Calories consumed at each meal (self-reported) and the number of people present	Yes	—
Schüz et al., 2018 (53)	61	Mean = 32	Mean = 25	M (n = 19) + F (n = 42)	Ecological Momentary Assessment task. At randomly timed prompts, and after every time they consumed a snack, participants recorded whether or not there was anyone in their presence who was also eating. Participants also recorded the extent to which they felt that others approved and encouraged them to eat at that moment (i.e., inductive norms). Participants completed the task over 14 days.	Probability of snack consumption versus random prompt	Yes	The effect of others eating on snack intake was partially mediated by the perceived approval/encouragement of eating.

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, y	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
Stroebele & de Castro, 2006 (54)	133	Mean = 21	Mean = 25	M (n = 29) + F (n = 104)	Over 7 days, participants recorded everything that they consumed and the number of people present at each meal. Subjective ratings of arousal (i.e., elation and excitement) were also recorded, and physiological arousal was recorded in a subset of participants, using heart rate monitors.	Calories consumed at each meal (self-reported), the number of people present, and subjective and objective measures of excitement and elation	Yes	SF found for intake of protein, fat, and carbohydrates. SF was not mediated by ratings of excitement/elation.
Nonexperimental: researcher-observed behavior								
Brindal et al., 2015 (55)	157	83.4% rated 15–25; 7.6% rated 26–35; 4.5% rated 36+	82% rated not overweight/obese	M (n = 86) + F (n = 71)	Subjects observed eating in a fast-food restaurant. Subjects ate in pairs (67.5%) or groups of 3 (19.7%), 4 (9.6%) or 5 or more (3.4%). Lone diners were not observed.	Foods eaten, meal duration, and the number of others present	No	Group size x participant gender x group composition interaction. Men in mixed-sex groups ate more than men in mixed-sex pairs. Women in same-sex groups ate more than those in mixed-sex groups. Amount eaten correlated with meal duration but not group size.
Cavazza et al., 2011 (Study 1) (15)	1685	Not reported. Excluded children who appeared younger than 13.	Not reported	M (n = 793) + F (n = 892)	Subjects observed eating in an Italian restaurant. Subjects ate alone (n = 22), in pairs (n = 259), or in groups of between 3–30 people (n = 228).	Mean number of dishes ordered; mean number of plates with leftovers; average bread and wine consumption	Yes	—

(Continued)

TABLE 1 (Continued)

Authors, year	<i>n</i>	Participant age, y	Participant BMI (mean; kg/m ²) or weight status	Participant gender(s)	Design	Primary outcome variable(s)	Evidence of SF?	Moderators/mechanisms examined
Klesges et al., 1984 (56)	539	Not reported	Not reported	M (<i>n</i> = 294) + F (<i>n</i> = 245)	Subjects observed eating in 7 fast-food and 7 formal-dining restaurants. Observers recorded whether subjects ate alone or in a small (1–3 people) or large (3+ people) group, and the gender composition of each group (i.e., mixed-sex/same-sex). Observers also recorded whether each subject was OW or NW.	Calories consumed	Yes	Moderating effect of gender. Women ate the same as men in small groups, but less than men in large groups.
Krantz, 1979 (57)	197	Estimated median = 27–28	101 rated obese; 96 rated NW	M (<i>n</i> = 106) + F (<i>n</i> = 91)	Students and staff observed eating at a university cafeteria at lunch time. Observers coded participants' gender, and whether or not they ate alone (<i>n</i> = 76) or with others (<i>n</i> = 121). Observations conducted across 20 restaurants in a large city in North America.	Calorie content and number of items chosen	Yes, only in non-OW subjects	Moderating effect of weight status: only non-OW subjects showed SF. OW individuals ate more when alone than with others.
Maykovich, 1977 (58)	553	30–50 years	15% obese; 16% OW	M + F	Observations conducted across 20 restaurants in a large city in North America.	Amount eaten	No	OW and obese individuals ate less when with others than when alone. For normal weight individuals, there was no difference in the amount eaten by those who ate alone versus those who ate with other people.
Young et al., 2009 (59)	469	Not reported	Not reported	M (<i>n</i> = 210) + F (<i>n</i> = 259)	Subjects observed eating at 3 university cafeterias. Subjects ate alone (<i>n</i> = 37), in pairs (<i>n</i> = 188), or in groups of 3 (<i>n</i> = 117), 4 (<i>n</i> = 80), 5 (<i>n</i> = 35), or 6 (<i>n</i> = 12).	Calorie content of foods selected	No	Moderating effect of gender. For women, the number of men in the group negatively predicted intake and the number of women positively predicted intake. Number of men or women did not predict intake for men.

¹NW, normal weight; OW, overweight; SF, social facilitation; TFEQ, Three-Factor Eating Questionnaire.

the 6 studies that did not restrict recruitment on the basis of weight status (and which reported BMIs), the mean BMIs ranged from 21 kg/m² to 27 kg/m².

The majority of studies compared eating behaviors when participants ate alone with when participants ate with others ($n = 12$). There were 2 studies that did not include an alone condition but compared eating behavior when participants ate in smaller versus larger groups (15, 24). In the majority of studies ($n = 13$), the primary outcome measure was the amount eaten. There was 1 study that recorded the number of dishes ordered in a mock restaurant scenario (15).

Of the 14 experimental studies, 9 reported using a cover story to disguise the aim of the study (15, 23, 25, 26, 31–35). However, only 1 study reported examining whether participants were aware of the study aims (31). In this study, 2 participants (out of 120) indicated that they were aware of the aims of the study. An inspection of funnel plots revealed no evidence of publication biases in experimental studies (Supplemental Figure 1).

Nonexperimental research.

Diary/ecological momentary assessment studies. Across the 13 studies which used diary methods (original data sets only), data were obtained from a total of 5047 participants. The majority of studies ($n = 12$) examined the social facilitation of eating in adults (mean age range: 21–53 years), and 1 study examined social facilitation effects in young infants (mean age: 13 months) (52). Across these studies, 3 recruited women only (48, 49, 51), and the remaining 10 included both men and women. Of the studies that examined social facilitation in adults, 3 did not report the participants' weight status (45, 48, 50), 1 study specifically recruited women with obesity (mean BMI: 32 kg/m²) (51), and 1 study recruited women who were underweight (mean BMI: 19 kg/m²) and normal weight (mean BMI: 24 kg/m²) based on metropolitan height and weight tables (49). For studies that did not restrict recruitment on the basis of weight status, the mean BMIs ranged from 20 kg/m² to 25 kg/m². There was 1 study that specifically recruited participants with treated or untreated bulimia (48), and 1 study that recruited participants with type 1 diabetes (43). Finally, 1 study (42) specifically recruited representative samples from French ($n = 26$), Dutch ($n = 50$), and American ($n = 140$) populations.

There were 9 studies that examined data that had been collected in previous research (3, 37–41, 44, 46, 47). The mean ages of participants in these data sets ranged from 32 to 44 years, and all studies analyzed data from both men and women. In these reanalyzed data sets, the mean BMIs of participants ranged from 23 kg/m² to 26 kg/m²; 2 studies did not report BMIs (3, 46).

In studies using diary methods, participants recorded everything they ate, the start and end time of each meal (to determine meal duration), levels of hunger and fullness, and the number of people who were present at each meal. In some studies, participants also recorded their mood (43, 49, 51) and the amount that they intended to eat (16).

Schüz and colleagues (53) used an ecological momentary assessment task in which participants recorded 1) whether other people were eating in their immediate environment (i.e., social eating cues), and 2) the extent to which they felt that eating was appropriate and encouraged. Records were taken

whenever participants ate a snack, and at randomly timed prompts throughout the day.

The majority ($n = 19$) of diary/ecological momentary assessment studies (original and reanalyzed data sets) examined eating behavior as a function of group size, and 7 compared eating behavior when participants ate alone with when they ate with others (37, 40, 45, 50, 51, 53, 54). In the majority ($n = 21$) of original and reanalyzed data sets, the primary outcome variable was the calorie content of a meal. Notably, the primary outcome of 1 study was the probability and amount of meat consumption (50). However, for the purpose of the current review, we also extracted the total energy content of meals reported in this study. In 1 study, the primary outcome was whether a snack was being consumed at each moment of assessment (53). Diary/ecological momentary assessment measures were taken over 4 (16, 50), 7 (36, 42, 43, 45, 48, 49, 52, 54), or 14 days (51, 53).

Researcher-observed behavior. Researcher-observed behaviors were recorded from a total of 3600 people and, in every case, both men and women diners were assessed. In 3 studies, participants' ages were estimated: Brindal and colleagues (55) estimated that 83.4% were between 15 and 25 years; Krantz (57) estimated the median age to be 27–28 years; and Maykovich (58) estimated that their sample was between 30–50 years. Subjects' weight statuses were estimated in 3 studies: 69% (58) and 82% (55) of subjects were rated as nonoverweight in 2 of the studies, and another study specifically sought to observe approximately equal numbers of subjects with ($n = 101$) and without ($n = 96$) obesity (57).

Observations were conducted in fast-food and formal-dining restaurants (15, 55, 56, 58), and in university or work cafeterias (57, 59). There were 3 studies that compared social facilitation effects when subjects ate alone to when they ate in groups (56–58), and 4 that examined the effect of group size on eating behavior (15, 55, 56, 59). The primary outcome variables included the amount eaten (55, 56, 58), the calorie content of foods selected (57, 59), and the number of dishes ordered (15).

Study findings

Meta-analysis results.

Of the 12 experimental studies that included an alone condition, 8 reported evidence of social facilitation (23, 25, 26, 29, 31–33, 35). Data from 11 studies (comprising 17 comparisons) that examined food intakes when participants ate alone and with others were entered into a meta-analysis. Data from 1 study were not included due to the pseudo-experimental method used (35). In separate blocks of 5 consecutive days, participants were asked to eat all of their meals “only with other people,” “only alone,” and “as normal,” and to record everything that they ate during each phase. This study was, therefore, methodologically different to other experimental research in which group sizes were manipulated and examined under controlled conditions.

The meta-analysis revealed an overall significant effect of social context on food intake ($Z = 2.57$; $P = 0.01$; $SMD = 0.35$, 95% CI: 0.08, 0.61; **Figure 2**). A high level of heterogeneity was detected across comparisons ($I^2 = 72\%$), and the forest plot suggests that stronger social facilitation effects are observed

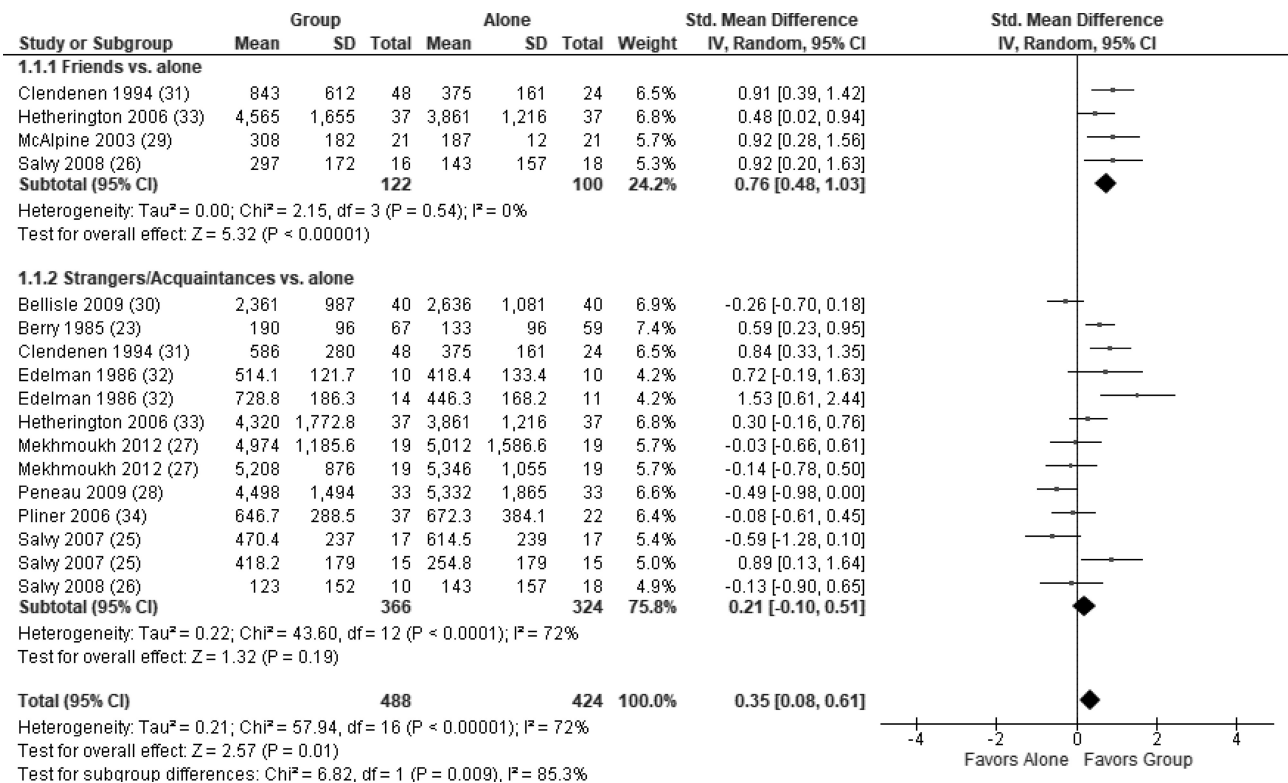


FIGURE 2 Forest plot for experimental studies comparing food intake when participants ate alone and/or in groups. Total refers to the number of participants. Studies are grouped based on whether participants ate with friends or with strangers/acquaintances. IV, independent variable.

when people eat with friends and family members than when they eat with strangers. We therefore conducted a subgroup analysis in which studies that specifically examined food intakes in groups of friends were analyzed separately from studies that tested groups of strangers/acquaintances. Specifically, comparisons from studies that had aimed to recruit groups of people who knew each other were included in the friends subgroup. Comparisons from studies that had examined social facilitation effects in strangers, or which had not attempted to recruit groups of friends, were included in the strangers/acquaintances subgroup. Notably, some comparisons within this subgroup involved participants who were recruited from the same school or workplace and who may, therefore, have been acquainted (e.g., 27, 28, 32, 34). Of these, 1 study assessed the degree to which participants knew each other on a 7-point Likert scale (1 = not at all to 7 = extremely) (34). The researchers noted substantial variability in the degree of familiarity between groups (8 groups provided a mean familiarity rating between 1.00–1.99 and 5 groups provided a mean rating between 6.00–6.99).

There were 4 studies that compared food intakes when participants ate alone and with friends, and 10 studies (contributing 13 comparisons) examined food intakes when participants ate alone and with strangers/acquaintances. A subgroup analysis revealed a significant effect of social context across studies that compared food intakes when participants ate alone and with friends ($Z = 5.32$; $P < 0.001$; $SMD = 0.76$, 95% CI: 0.48, 1.03). Specifically, these comparisons revealed greater food intakes when participants ate with friends, compared to when they ate alone. However, no significant effect of social

context was observed in studies which compared food intakes when participants ate alone and with strangers/acquaintances ($Z = 1.32$; $P = 0.19$; $SMD = 0.21$, 95% CI: -0.10, 0.51).

Narrative synthesis.

Comparisons between eating alone and eating in groups. In studies using diary techniques, meal sizes were between 29% and 48% larger when participants ate with others, compared with when they ate alone (37, 45, 54.). Horgan et al. (50) found that participants ate up to 23% more calories when eating with friends, family, or colleagues, relative to when eating alone. Among women with obesity, social meals were 29% larger than meals eaten alone (51). Furthermore, using an Ecological Momentary Assessment task, Schüz et al. (53) found that the presence of others who were eating significantly increased the odds that a measurement occasion represented a “snack report,” compared with a “random report” (OR 4.18). There were 2 researcher-observed behavior studies that found that subjects eating in groups selected or consumed 12% more calories than did those eating alone (56, 57). However, Krantz (57) reported this social facilitation effect only in normal-weight subjects; overweight men and women selected 18% less food when with others, relative to when eating alone (587 vs. 479 kcals). There was 1 researcher-observed behavior study that found no evidence that subjects eating in groups ate more than those eating alone (58).

Familiarity. The results from our meta-analysis suggest that familiarity with one's dining companion(s) is a significant moderator of social facilitation effects on eating. No effect of eating in a group versus eating alone was observed in studies in which the participants were eating with strangers/acquaintances, whereas significant social facilitation effects were observed in the small number of studies that tested people in groups of familiar others (26, 29, 31, 33). These findings are consistent with those obtained from a diary study in which the amount consumed was predicted by group size when subjects ate with friends and family, but not when they ate with (presumably less familiar) coworkers (40).

Gender. There was 1 researcher-observed behavior study that reported that women ate the same amount as men when in smaller groups (less than 3 people), but ate significantly less than men in larger groups (56). Consistent with that finding, a self-report study found a stronger correlation between meal size and the number of people present in men, compared with women (36). However, experimental studies have reported no significant 2-way interactions between gender and social context (23, 25, 28, 34). Notably, these experimental studies did not compare social facilitation of eating in men and women who were friends, and this may have obscured any gender differences.

Berry et al. (23) reported an interaction between food variety and social context that differed between men and women. Specifically, both men and women ate more in a group, relative to alone, when they were given 1 flavor of ice cream. However, when given 3 flavors of ice cream, social facilitation was only observed in women.

There were 2 researcher-observed behavior studies that reported an interaction between the subject's gender and the gender composition of the group. Specifically, Brindal et al. (55) found that men, but not women, ate more when eating in mixed-sex groups of 3 or more people, compared with mixed-sex pairs. Similarly, Young et al. (59) found that, for women, calorie selection was negatively predicted by the number of men in a group, and positively predicted by the number of women in a group. In contrast, neither group size nor gender composition significantly predicted calorie selection in men. The degrees of familiarity between co-eaters in these researcher-observed behavior studies were not reported (55, 59).

Dietary restraint/weight status. There were 2 experimental studies that examined social facilitation in eaters who were more and less restrained (30, 31). Bellisle and colleagues found no overall social facilitation effect, and this did not differ according to dietary restraint (30). Clendenen et al. (31) reported social facilitation of eating among familiar participants, but no moderation by dietary restraint. Similarly, a diary study found that the number of people present at a meal predicted food intake, irrespective of dietary restraint (41). There was 1 study that found that the strength of the social correlation did not differ significantly between those with high and low external eating scores (assessed using the Dutch Eating Behavior Questionnaire) (16).

There were 2 researcher-observed behavior studies that examined whether the effects of social contexts on food intake differed

as a function of participants' weight status (57, 58). Krantz (57) reported social facilitation effects only in nonoverweight subjects, while overweight subjects eating alone selected more calories than did those eating with others. Maykovich (58) reported no effect of social context on the amount of food consumed in nonoverweight individuals, while subjects who were overweight or obese ate less when with other people, compared to alone. Salvy et al. (25) found that social facilitation effects were only evident in nonoverweight children; overweight children ate more when eating alone, compared with when they ate with others. Contrary to these findings, 1 experimental study reported no effect of social context on eating behaviors in normal weight and overweight male adolescents (27). Furthermore, Edelman et al. (32) found that social facilitation effects on eating were not significantly moderated by weight status in men. However, the experimental studies described above examined food intake among strangers/acquaintances (25, 27, 32); to our knowledge, there has been no experimental examination of the moderating effect of weight status on social facilitation within groups of friends.

Food type. Several diary studies examined whether social facilitation is observed across various meal types. There were 3 that found greater social facilitation effects for foods high in fat and/or protein and lower in carbohydrates (35, 45, 51), and 1 study (54) that reported social facilitation effects across all food types (i.e., across foods high in fat, protein, and carbohydrates). Horgan et al. (50) found that meals consumed with others were more likely to contain meat than meals eaten alone. There was 1 experimental study that also demonstrated an 18% increased intake when individuals ate with a friend, compared with when they ate alone, and the social facilitation effect was particularly enhanced for high-fat, sweet food (55%) (33). However, Clendenen et al. (31) found that participants eating in groups of 4 friends did not consume more sweet or savory foods than those eating in groups of 2. Several experimental studies found no evidence of social facilitation for foods high or low in fat and/or sugar (i.e., casserole, cake, fruit sherbets, pizza, and cookies) (27, 28, 30, 34). The null effects obtained in these studies are likely due to the fact that they examined food intakes among groups of strangers/acquaintances, and not friends.

The social correlation. Diary studies have found small to moderate correlations between the number of people present at a meal and the meal size in healthy adult populations (16, 36, 38, 39, 41–46, 48, 51). Heusel and de Castro (49) found a correlation between the number of people present and the meal size, and reported that this was true for both healthy weight and underweight women.

De Castro et al. (3) reported a social correlation across both meals and snacks, and in meals consumed with and without alcohol. However, 1 study found that the social correlation was only evident for snacks and for meals eaten at breakfast; there was no social correlation for meals eaten at lunch and dinner (16). In a reanalysis of existing data sets, de Castro and Brewer (46) reported a nonlinear relationship between meal size and the number of people present. Specifically, eating with 1 other person was associated with a 28% larger meal size, relative to eating

alone, while those eating with 2, 3, 4, 5, and 6 or more people had 41%, 53%, 53%, 71%, and 76% increases in meal sizes, respectively.

There was 1 researcher-observed behavior study that reported a greater number of dishes ordered as a function of increased group size (15). Cavazza et al. (15) also found that the number of dishes ordered in a mock restaurant could be predicted by the size of the group. This was moderated by trait self-monitoring (i.e., the degree to which an individual is motivated to act appropriately), such that social facilitation effects were only observed for those who scored high on this trait. In contrast, 3 researcher-observed behavior studies found no effect of group size on the energy content of foods selected (59) or eaten (55, 58). Klesges et al. (56) also reported that women ate less in larger, compared with smaller, groups. There was 1 experimental study that reported no effect of group size on intake; participants did not eat more in groups of 4 compared with when eating in pairs (31).

The social correlation has also been investigated in children. In 1-year-old infants, there was a weak correlation ($r = .14$) between the number of people who were present during feeding and the amount the infants ate (52). Another study found that, after controlling for snack duration, children ate more when eating in groups of 9, compared with groups of 3 (24). There was also a group size by meal duration interaction, such that, for children who ate for longer durations (>11.4 minutes), those in larger groups ate 30% more than did those in smaller groups. For those children who ate for shorter durations (<11.4 minutes), there were no differences in the amounts eaten when groups of 3 and 9 children were compared (24).

Meal duration. Several studies have examined whether social facilitation effects on eating can be explained by a longer meal duration for those eating in groups, relative to those eating alone (or in larger groups relative to smaller groups). Using a diary approach, 4 studies reported positive correlations between group size, food intake, and meal duration (16, 37, 40, 46). Partially consistent with these findings, 1 researcher-observed behavior study found that food intake correlated positively with meal duration, but not with group size (55). The meal duration also significantly mediated the relationship between group size and food intake (16). In addition, Feunekes et al. (16) reported an indirect effect of group size on intake via participants' ratings of the atmosphere (rated on a 10-point scale from "unsociable" to "sociable") and the meal duration. Interestingly, 1 study found that the mechanisms by which the social context facilitated intakes differed between types of companions; specifically, eating with friends and eating with family members facilitated intakes via an increased meal duration and a faster eating rate (calories consumed per minute), respectively (40).

Experimental research has uncovered a relationship between meal duration, group size, and food intake. Specifically, Redd and de Castro (35) reported longer meal durations and larger meal sizes when participants ate with others, compared to when they ate alone. Furthermore, Clendenen et al. (31) found that participants eating in pairs took significantly longer to eat, and ate more, than did those eating alone or in groups of 4 (although the amount eaten did not significantly differ between those eating in pairs and groups of 4). To directly examine the role of meal duration, 1 study limited meals to a shorter (12 minutes)

or longer (36 minutes) duration when participants ate alone, in pairs, and in groups of 4 (34). Participants in the longer duration condition ate more than did those in the shorter duration condition; however, the food intake was not affected by the social context.

While the majority of evidence supports the idea that a longer meal duration plays an important role in the social facilitation of eating, findings from 2 experimental studies suggest that an extended meal duration is neither necessary nor sufficient for the social facilitation of eating. There was 1 study that found that, for those who ate for longer durations (i.e., >11.4 minutes), children in groups of 9 consumed 30% more than did those who ate in groups of 3 (24). Furthermore, Hetherington et al. (33) found longer meal durations when participants ate with friends and strangers, relative to alone, yet social facilitation effects were only observed when participants ate with friends.

Distraction. There were 4 experimental studies that compared the effects of the social context and other forms of distracting activities on eating. Of these, 3 reported increased intakes when participants ate while watching TV or listening to a story or to music, relative to when they ate without distraction, but found no evidence for social facilitation (27, 28, 30). Notably, none of these studies examined eating when participants were with friends (instead, participants ate with strangers/acquaintances). In contrast, Hetherington et al. (33) found that participants consumed 18% more food when they ate with friends and 14% more food when they ate while watching TV, relative to when they ate alone with no distraction. This increased intake also coincided with the extent to which each activity distracted participants away from the lunch meal; participants spent significantly less time looking away from the lunch meal (indicative of less distraction) when eating alone, compared to when watching TV or eating with a friend. However, while eating with friends and strangers distracted participants' attention away from the food to the same degree, increased intakes were only observed when participants ate with friends (33).

Mood. Several diary studies examined whether social facilitation effects were attributable to the effect of the social context on mood. There were 3 studies that reported increased levels of elation and anxiety prior to and after eating with others, compared with eating alone (37, 40, 54), although there was no correlation between group size and an objective measure of arousal (i.e., heart rate) (54). Other findings have suggested that levels of elation and anxiety cannot adequately account for the social facilitation of eating. Firstly, de Castro (37) found that differences in elation ratings between meals eaten alone and socially accounted for just 2% of the variance in meal sizes. Secondly, subjective mood ratings were not significant predictors of meal size when entered into a multiple linear regression with group size (37, 54). Finally, de Castro (40) reported greater social facilitation when participants ate with friends or spouses, compared to when they ate with coworkers, despite the fact that eating with coworkers was associated with greater levels of anxiety and elation.

Norms of appropriate intake. There was 1 study that examined whether the effects of social contexts on food intake were due to normative influences (53). Using an Ecological Momentary Assessment task, Schüz et al. (53) reported that the relationship between the social context and snack intake was mediated by the extent to which participants perceived eating to be encouraged and appropriate. Across 2 studies, Cavazza et al. (15) reported that people ordered more food as a function of group size, and that the number of dishes ordered by each individual in a group corresponded highly with the number of dishes ordered by others in the group. This finding provides further evidence for the role of norms as a potential mechanism behind the social facilitation of eating. In their normative perspective of social eating, Herman and colleagues (60) suggested that individuals eating socially generally try to eat as much as possible, without being seen to be eating excessively; that is, they attempt to eat no more than the largest eater in the group. This may lead to positive feedback, whereby the larger norm set by 1 individual permits the greater intake of another, and vice versa. This is consistent with the idea that social eating provides a license to indulge (60).

Food palatability/appetite. There was 1 diary study that found that the palatability of the meal was associated with the size and gender composition of a group. Specifically, men and women rated meals eaten with 1 woman as more palatable than meals eaten with many women, while the number of men was not related to palatability ratings (36). However, Feunekes et al. (16) found that food palatability did not mediate the relationship between group size and intake. No studies have examined whether the social context moderates changes in appetite during the course of a meal, although McAlpine et al. (29) found that when participants ate alone or with others, their pre- and post-meal ratings of hunger, fullness, and desire to eat changed to the same extent. This was despite the fact that those who ate in groups consumed 60% more calories than did those who ate alone.

Discussion

We found strong evidence that people eat more food when eating with familiar others, compared with when they eat alone. Social facilitation was not observed across studies that examined eating among groups of strangers or acquaintances. The effect of social facilitation on food intake (when eating with friends; $d = .76$) is considerably larger than that of portion size ($d = .45$) (61), and is similar to the large effect reported for modeling of eating ($d = .85$) (62). We found that evidence for the social correlation is weak, and that the available evidence provides limited insight into the mechanisms underlying the social facilitation of eating.

Moderators of social facilitation effects

The majority of experimental studies we reviewed recruited groups of strangers/acquaintances, and across these studies there was no significant facilitation of eating. However, a significant social facilitation effect was observed across 4 studies that tested groups of familiar others, and the size of this effect was large ($d = .76$). In addition, social facilitation of eating was observed

consistently across diary studies, which may be due to the fact that the majority of self-selected dining groups likely comprised friends and family. The moderating effect of co-eater familiarity has been alluded to in previous reviews (7, 60), but here we provide the first quantitative evidence for such a moderation. It remains unclear whether social facilitation effects on eating are more pronounced in very close friends, relative to less close friends; this may be an avenue for future research.

We also found some evidence that social facilitation effects are attenuated when women eat in groups that include men (55, 59) and when people who are overweight/obese eat with lean people (19, 21, 25, 57, 58). These effects are likely explained by impression management concerns. People are motivated to convey positive impressions to strangers (63, 64), and selecting small portions may provide a means of doing so (6, 62, 65, 66). Impression management concerns are likely to be particularly pronounced for women eating with men whom they wish to impress and for people with obesity who are eating with lean dining companions and wish to avoid negative judgments related to perceptions of overeating (63).

Social contexts may specifically facilitate the intake of indulgent foods (33, 35, 51), but the moderating effect of food type on social facilitation has not been assessed directly. In addition, de Castro et al. (3) reported social facilitation effects across all meal types, but Feunekes et al. (16) found that the positive correlation between group size and meal size was only significant for breakfast meals and snacks. Further research is required to establish the robustness of social facilitation effects with different food types and meals.

The social correlation

Evidence from diary studies suggested a positive correlation between the number of people present and the amount consumed by an individual in that group, but only up to about 6 people, after which no further increases were observed (46). At the same time, evidence from researcher-observed behavioral studies and experimental studies is more mixed: some studies found a positive social correlation (15), while others reported no effect (31, 55, 56, 59). At present, there are not sufficient data to be able to determine how factors such as the degree of acquaintance of the group members may influence the social correlation. It is possible that when a group includes even 1 member who is less well known to other group members, impression management concerns are heightened and the size of the social correlation is reduced.

Mediators of the social facilitation of eating

Only 2 studies have formally examined the mechanisms behind social facilitation using mediation analyses (16, 53). The results suggest that social facilitation can be partly explained by longer meal durations (16) and perceptions about the appropriateness of eating (53). However, longer meal durations have been found to be neither necessary nor sufficient for social facilitation (33). Another possibility that has yet to be tested is that social contexts affect eating via effects on hunger/food palatability. Ogdén et al. (12) found a positive relationship between the amount consumed in a social situation and post-meal ratings of hunger, but this study examined intakes while participants talked with the researcher

(i.e., there was no co-eater). There is evidence that eating in company enhances food palatability (18, 22, 36), but this has yet to be examined as a mediating mechanism of social facilitation.

Gaps in knowledge and a framework for future research

In order to be able to fully investigate the moderators and mediators of the social facilitation of eating, it will be necessary to minimize the effects of impression management concerns and to conduct studies on participants who are well known to each other.

Previous research has tended to focus on the effect of social contexts on immediate food intakes, and the effects on longer-term intakes have yet to be thoroughly investigated. Diary studies have found no correlation between the number of people present at a meal and food intake at a subsequent meal, suggesting that people do not reduce their food intake after consuming a large meal socially (45, 46). However, using survey methods, a recent study found a significant, positive correlation between social meal frequency and energy intake for women, but not men (67). Clearly, this issue deserves further investigation, because the uncompensated social facilitation of eating could play a role in promoting chronic overeating and obesity.

There are several other mechanisms that might promote food sharing and explain why people eat more in groups than they do alone. Eating with others may be more enjoyable, and the enhanced reward from social eating might serve to increase consumption. Alternatively, social norms might license overeating in company but sanction it when eating alone, and they might encourage greater food sharing because social eating provides an opportunity to consume a larger meal (60). Food sharing might also be promoted if the act of providing food becomes associated with praise and recognition from the social group, thereby strengthening social bonds. Indeed, larger quantities of food are often anticipated and made available (per capita) even before a meal begins (15), a phenomenon referred to as the social “pre-cilitation” of intake (6).

Finally, and in relation to our question about why social facilitation occurs, it may be helpful to dissociate different levels of explanation. Behavioral ecologists sometimes draw a distinction between why and how. Ultimate explanations consider why a behavior confers an adaptive advantage, whereas proximate explanations refer to how this benefit might be realized (68). For example, omnivores will seek to reduce foraging costs because (why) this reduces the risk of predation. However, the ability to do so (how) is governed by a tendency to find energy-rich food especially rewarding (69). In this review, we have focused on plausible proximate mechanisms. However, the underlying (ultimate) reason(s) why social facilitation occurs are rarely considered. As with many other species, humans tend to share a common food resource. However, in humans this is especially true, and many have suggested that hunter-gatherers even adopted an active, egalitarian approach to resource distribution (70). Active food sharing probably confers a broader benefit, because it protects against periods of food insecurity. A person’s day-to-day foraging success is likely to be variable. However, when spread across a group this risk is reduced, and on occasions when a large animal is killed and more meat is available than can be consumed by a single individual, it can be distributed before it spoils. Accordingly, in modern hunter-gatherers, meat

is not available every day and food sharing is ubiquitous (70), probably because the cost of sharing is low relative to the benefit from receiving meat from others.

Why, then, does social facilitation promote an increase in food consumption, relative to solo eating? First, it is perhaps important to note that the same process has been observed in numerous other species, including chickens (71, 72), rats (73), and gerbils (74). Since social facilitation is conserved across so many species, this suggests it serves an ultimate purpose. Although inclusive fitness may be enhanced by strong social collaboration, individuals also compete for resources. Eating more than others is likely to lead to ostracism, which, in turn, reduces food security. Therefore, a tension is created between being seen to engage in altruistic sharing and procuring the maximum personal resources. We suggest that when eating socially, a simple solution might be to consume at least as much as others in the group. Hence, social facilitation might occur because individual group members are guided to match their behavior to others, promoting a larger meal than might otherwise be eaten in the absence of this social competition. Although a single meal will have a trivial impact on energy reserves (75), a chronic failure to adopt this strategy (or similar) might have a serious impact on relative fitness. In this way, social facilitation can be viewed as a natural byproduct of social food sharing: a strategy that would have served a critical function in our ancestral environments. The suggestion that social facilitation occurs in response to food sharing also explains why it is confined to individuals who are familiar with each other: food sharing relies on a long-standing reciprocal exchange of food supplies that is unlikely to occur with strangers.

Of course, most humans are no longer hunter-gatherers. Nevertheless, proximate mechanisms that once served efficient foraging continue to guide our dietary behavior (for a review, see 76). Indeed, the recent and rapid transition to a dietary landscape in which food is abundant has created forms of evolutionary mismatch, whereby these inherited foraging strategies no longer serve their ultimate purpose. In the case of social facilitation, we have inherited a mechanism that ensured equitable food distribution but which now exerts a powerful influence on unhealthy dietary intakes.

Theoretical and practical implications of research on the social facilitation of eating

Traditionally, social influences on eating have been conceptualized as independent influences on appetite, separate from the fundamental motivational processes that underpin the control of food choices. However, more recent theorizing on appetite control has suggested that social and motivational influences on eating are part of an integrated system in which decisions about what and how much to eat are informed by representations of the value of a particular food item at any given moment, and that these representations of value are influenced by beliefs about the nutritional value of foods and many other factors, including cultural and social factors (e.g., 77, 78). This theory can be tested by investigating whether eating with others increases amounts consumed via enhancements of the value assigned to food in that context.

If it turns out that eating socially is a driver of positive energy balance, then this will raise questions about whether the avoidance of social eating situations should be recommended for

weight control. Social eating is generally considered as positive, because it may contribute to better interpersonal relations and enhanced wellbeing. For example, research on family meals suggests that regular eating in a family group is positively associated with wellbeing (e.g., 79). Furthermore, solo eating is often viewed negatively, and people report that they would prefer not to do so (80, 81). Hence, advice to eat alone may be neither desirable nor acceptable. An alternative approach would be to suggest strategies that might mitigate overeating, so that people can experience the benefits of social eating while avoiding potential effects on weight gain.

In conclusion, we present the first systematic review and meta-analysis of the social facilitation of eating. Our results suggest that eating with familiar others has a powerful effect of increasing food intakes, relative to eating alone. However, further work is required to assess the moderators and mediators of this effect and the contribution of social eating to a positive energy balance. Such research will have important implications for the development of weight management strategies. We argue that future research on the social facilitation of intakes might be usefully guided by our new framework, which proposes that the social facilitation of eating has evolved as a strategy that ensures the procurement of maximum personal food intake in the context of food sharing.

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