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The influence of experimental confederate peers on children's food intake: A systematic review and meta-analysis

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Abstract

Confederates influence eating behaviour. Systematic reviews and meta-analyses have been conducted on this topic, however, the majority have examined adults, or a combination of adults and children, therefore, an up-to-date meta-analysis is needed to examine the impact of confederate peers on children's food intake. We systematically reviewed and meta-analysed the influence of confederate peers on children's food intake in research using present and remote-confederates. Six publications summarising findings from seven studies were included in this review. One publication was excluded from the meta-analysis because it was not possible to extract the required data. The meta-analysis showed that children were influenced by confederate peers; eating more when exposed to a high-intake compared to a no or low-intake confederate. Larger effects were observed when children were exposed to a remote-than a present-confederate, and for studies using healthy snacks compared to high fat high sugar (HFHS) snacks. No difference in effect size was observed when children were exposed to a high-vs. low-intake confederate compared to a high-vs. no-intake confederate. In the narrative synthesis, confederate intake influenced children's eating behaviour 24-h later, and possible moderators and a potential mechanism underlying the influence of confederates were identified. Caution is needed when interpreting the results, as the sub-groups were not compared statistically due to high heterogeneity, and a small number of studies were included in this review. Furthermore, all studies using the present-confederate design examined HFHS snack intake, therefore, it is unclear

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Author contributions

MS was involved in conceptualisation, data curation, formal analysis, investigation, methodology, and writing (original draft and review and editing). HC was involved in conceptualisation, formal analysis and writing (original draft and review and editing). SS was involved in writing (original draft and review and editing). SR was involved in formal analysis and writing (review and editing). VF was involved in formal analysis and writing (original draft and review and editing).

Ethical statement

This systematic review and meta-analysis did not require the collection of new data and therefore did not require ethical approval.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.appet.2021.105863.

whether observed differences in effect sizes between present- and remote-confederates may be due to confederate or food type. Research is needed to further examine the influence of confederate peers on children's food intake and to examine mechanisms and moderators.

Keywords

Food intake; Experimental confederates; Children's food intake; Eating behaviour; Social influence

1. Introduction

Eating behaviour has consistently been shown to be influenced by others (Robinson, Thomas, Aveyard, & Higgs, 2014; Ruddock, Brunstrom, Vartanian, & Higgs, 2019; Vartanian, Spanos, Herman, & Polivy, 2015). Adults and children eat more when exposed to a present confederate who has been instructed to eat a large amount, and less when exposed to a present confederate who has been instructed to eat a small amount or abstain from eating (Bevelander, Anschütz, & Engels, 2012; Hermans, Larsen, Peter Herman, & Engels, 2012; Robinson, Tobias, Shaw, Freeman, & Higgs, 2011). Remote-confederates are confederates who are not present in the room (i.e. either visible on a video or computer screen or information is provided about how previous fictitious participants have behaved in the study) and also influence eating behaviour in adults and children in the same way as present confederates (Bevelander, Anschütz, Creemers, Kleinjan, & Engels, 2013; Feeney, Polivy, Pliner, & Sullivan, 2011; Herman & Polivy, 2005; Robinson et al., 2014; Romero, Epstein, & Salvy, 2009; Sharps & Robinson, 2017; Vartanian et al., 2015). According to the normative model of social influence, people are influenced by the eating behaviour of others, as other people are believed to act as a guide for the appropriate amount to eat in a situation, allowing people to eat as much as possible without appearing to eat excessively (Herman, Roth, & Polivy, 2003).

While several reviews have examined the impact of peers (including confederates) on children's eating behaviour (DeCosta, Møller, Frøst, & Olsen, 2017; Houldcroft, Haycraft, & Farrow, 2014; Salvy, de la Haye, Bowker, & Hermans, 2012; Vartanian et al., 2015), only one meta-analysis has been conducted on this topic (Vartanian et al., 2015). In Vartanian et al.'s (2015) meta-analysis, data were included from studies in both adult and child populations and showed that confederate intake influenced food intake in both adults and children. However, more research has examined the influence of remote-confederate peers on children's eating behaviour since this review was published. Therefore, an updated meta-analysis on the influence of confederate peers (i.e. the influence of children acting as confederates) on children's food intake is warranted.

In this systematic review and meta-analysis, we aimed to examine the effect of confederate peers (present and remote) on 5–12-year-old children's food intake in experimental studies. We aimed to conduct sub-group analyses to examine whether the size of the effect differed when children were exposed to present vs. remote-confederate peers, when children were exposed to high vs. low compared to high vs. no intake confederates, and when children were exposed to healthy vs. high fat high sugar (HFHS) snack foods. Depending on the

number of available studies, we also aimed to meta-analyse the impact of moderators measured in the studies (such as weight-status), and to discuss all other results in a narrative synthesis.[1]

2. Subjects and methods

2.1. Eligibility criteria

2.1.1. Participants, studies, and outcome measures

2.1.1.1. Included.: Studies eligible for inclusion examined 5–12-year-old children. We were particularly interested in the role of confederate peers on primary school children's eating behaviour due to the unique eating environment within primary schools where children sit together in a structured environment and are likely to be eating similar foods. The studies were quantitative experimental studies in human volunteers examining 1) the influence of present or remote confederate peers, and 2) the influence of exposure to a high-intake vs. a low or no-intake confederate peer on children's food intake.

2.1.1.2. Excluded.: Interventional and experimental studies involving parental influences were excluded, as were studies involving children with health problems or learning difficulties (e.g. eating disorders or learning disabilities). Studies measuring food choice, those involving two or more free-eating participants, those including an adult confederate, and studies examining the impact of social norm messages (e.g. messages indicating the general behaviour of others and not specifically how people had behaved in the study) were excluded. Studies which did not include a low- or no-intake condition (i.e. only examined high-intake confederates) were also excluded.

2.2. Information sources and search strategy

Three electronic databases were searched: Medline (pubmed), Psy-cINFO and Web of Science in June 2020 and again in March 2021 to check for any new articles (no additional articles were found or included in March 2021). The first author and a research assistant (SR) both ran the searches and screened 100% of the titles, abstracts and full texts. Any discrepancies were discussed and resolved. Searches included a combination of key words relevant to peer influence and children's eating behaviour (see supplemental data for the full search strategy). The electronic searches were supplemented with a manual search of reference sections in articles identified by the electronic search and other relevant sources. The author of one article was contacted to retrieve data, however this proved unsuccessful and the paper is included in the narrative review but could not be included in the meta-analysis. The search process was guided by the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines. See Fig. 1 for the PRISMA flowchart.

2.3. Quality assessment

Consistent with previous systematic reviews and meta-analyses (Robinson et al., 2013, 2014; Ruddock et al., 2019), quality checks for randomised controlled trial and epidemiological studies were not relevant, as these approaches were not used in any of the studies identified

[1]This systematic review and meta-analysis was registered on Prospero prior to starting CRD42019128542.

in the current review. However, we examined whether studies used designs which made it unlikely that the children became aware of the true aims of the studies, and we examined whether the studies reported the children's awareness of the study aims.

2.4. Data extraction

For each study, we extracted the following information: 1) sample characteristics, 2) design, 3) primary outcome measures, 4) main findings, 5) moderators. If data required for the meta-analyses (e.g. means and SDs) were missing, lead authors of 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. See Table 1 for data extraction.

2.5. Data synthesis

An inverse variance meta-analysis was used to combine the results from experimental studies comparing food intake when participants ate with a high-vs. a low- or no-intake confederate (either present or remote-confederates). Revman (Cochrane) version 5.4 was used to calculate the standardized mean difference (SMD) between the high and low/no-intake conditions for each study and its 95% CI, and assessed heterogeneity with the I^2 statistic. A positive SMD indicates that people ate more when exposed to a high-intake confederate peer compared to a low- or no-intake confederate peer. Studies comparing high-vs. low-intake confederate peers, and those comparing high-vs. no-intake confederate peers were included as separate comparisons in the analysis. Only one study, however, compared low- and no-intake confederate peers; therefore, it was not possible to meta-analyse this comparison. Sub-group analyses were conducted to compare the findings from studies that had examined the effect of confederate intake when children were exposed to present confederate peers, and from studies that had examined the effect of confederate intake when children were exposed to remote confederate peers. Sub-group analyses were also conducted to compare the findings from studies that compared high-intake to no-intake confederate peers, and high-intake to low-intake confederate peers, and to compare studies that used healthy and HFHS snack foods. We originally aimed to statistically compare the sub-groups in each sub-group analysis, however, due to high heterogeneity ($I^2 > 50\%$) across all sub-groups, this analysis was inappropriate. Therefore, SMDs were calculated separately for each sub-group. Effect sizes were interpreted using the SMD and interpreted as Cohen's d (Becker, 2000).

3. Results

3.1. Overview

3.1.1. Search results—Initial searches identified 936 publications after duplicates were removed, 68 publications were fully assessed (67 identified from the searches, and one from reference searching). A further 62 articles were excluded on the following basis: not present or remote confederates (n = 21), not objectively measured food intake (n = 15), multicomponent intervention (n = 7), not an experimental study (n = 7), not a peer-reviewed paper (n = 4), not 5–12 year old children (n = 4), not eating behaviour (n = 2), not healthy children (n = 1), no low or no-intake comparison (n = 1). This resulted in six

publications, but seven studies (two studies in Sharps & Robinson, 2017) included in the narrative synthesis and five publications summarizing the findings of six studies included in the meta-analysis, due to an issue with data extraction in one study (Bevelander, Anschütz, et al., 2013). See Fig. 1.

3.1.2. Participants—Data were collected from 871 children across the seven studies included in this review (range n = 44 to 223 participants). All studies used experimental designs and measured food intake through weighing the food. All studies reported original data and no studies reanalysed secondary datasets. Participants' mean age was 9 years and 9 months (SD = 1.24 years). The majority of studies recruited boys and girls and the samples consisted of approximately 50% girls. One study recruited girls only (Romero et al., 2009).

3.1.3. Overview of studies—Four studies compared the effect of high-vs. no-intake confederate peers (Bevelander, Meiselman, Anschütz, & Engels, 2013; Sharps & Robinson, 2015, 2017), two studies compared the effect of high-vs. low-vs. no-intake confederate peers (Bevelander et al., 2012; Bevelander, Anschütz, et al., 2013), and one study compared high-vs. low--intake confederate peers (Romero et al., 2009) on children's intake. All of the studies used confederate peers who were of a similar age to the children participating in the studies. The children were exposed to the confederate peer for 7 min in three studies (Sharps & Robinson, 2015, 2017), 10 min in three studies (Bevelander et al., 2012; Bevelander, Anschütz, et al., 2013; Romero et al., 2009), and for at least 11 min in one study (Bevelander, Meiselman, et al., 2013). Children in all studies were told a cover story and were told that the food was available if they wished to help themselves. The cover stories involved playing games in six of the studies (unrelated to food e.g. a puzzle, animal pairs game) and watching a short film clip in one study (Bambi; Bevelander, Meiselman, et al., 2013). In all studies included in this review the confederate peers were unknown to the children, with studies with present confederates using children from different year groups to ensure that they were not friends.

3.2. Study findings

3.2.1. Meta-analysis results—Six studies from five articles were included in the meta-analysis (Bevelander, Meiselman, et al., 2013; Bevelander et al., 2012; Romero et al., 2009; Sharps & Robinson, 2015, 2017). One study compared a high-to no- and low-intake confederate peer (Bevelander et al., 2012), and both of these comparisons were included in the main analysis, resulting in seven comparisons from six studies. All six studies reported evidence of children's intake being influenced by a confederate peer. The meta-analysis revealed an overall significant effect of confederate peer intake on children's food intake ($Z = 7.04$; $p < .001$; SMD = 0.62, 95% CI: 0.45, 0.79; Fig. 2). These comparisons revealed greater food intake when children were exposed to a high-intake confederate peer, relative to when exposed to a low- or no-intake confederate peer. The results showed a medium effect and a low level of heterogeneity was detected across comparisons ($I^2 = 19\%$).

3.2.2. Sub-group analyses

3.2.2.1. Present vs. remote-confederates.: Two studies (but three comparisons: high-vs. no- and high-vs. low-intake confederates in Bevelander (2012) and high-vs. no-intake

in Bevelander 2013) examined the influence of present confederate peers. There was a significant effect of confederate intake on children's food intake (Z = 4.66, $p < .001$, SMD = 0.47, 95% CI: 0.27, 0.67; Fig. 2), indicating a medium effect, whereby, children exposed to a high-intake present confederate peer ate significantly more than children exposed to a low- or no-intake present confederate peer. Four studies examined the influence of remote-confederate peers and were included in the sub-group analysis (Romero et al., 2009; Sharps & Robinson, 2015, 2017). There was a significant effect of remote-confederate peer intake on children's food intake (Z = 6.65, $p < .001$, SMD = 0.83, 95% CI: 0.58, 1.07; Fig. 2), indicating a large effect, whereby exposure to a high-intake remote confederate influenced children to eat more than exposure to a low- or no-intake remote confederate.

3.2.2.2. High vs. no and high vs. low intake confederates.: Five studies compared a high-vs. no-intake confederate peer on children's food intake (Bevelander et al., 2012; Bevelander, Meiselman, et al., 2013; Sharps & Robinson, 2015, 2017). There was a significant effect of confederate intake on children's food intake (Z = 7.00, $p < .001$, SMD = 0.69, 95% CI: 0.50, 0.88; Fig. 2), indicating a medium effect. The results showed that exposure to a high-intake confederate peer increased children's intake relative to exposure to a no-intake confederate peer. Two studies examined the influence of a high-vs. low-intake confederate peer on children's food intake (Bevelander et al., 2012; Romero et al., 2009). There was a significant effect of confederate intake on children's food intake (Z = 2.90, $p = .004$, SMD = 0.42, 95% CI: 0.14, 0.71; Fig. 2), indicating a small-medium effect. The results showed that exposure to a high-intake confederate peer increased children's intake relative to exposure to a low-intake confederate peer.

3.2.2.3. Healthy vs. HFHS snack foods.: Three studies examined the influence of confederate intake on children's healthy snack food intake (vegetables) (Sharps & Robinson, 2015, 2017). There was a significant effect of confederate intake on children's healthy snack food intake (Z = 6.37, $p < .001$, SMD = 0.87, 95% CI: 0.60, 1.13; Fig. 2), indicating a large effect. Three studies (but four comparisons: high-vs. no-intake and high-vs. low-intake in Bevelander (2012), high-vs. no-intake in Bevelander., 2013, and high-vs. low-intake in Romero et al., 2009) examined the influence confederate intake on children's HFHS snack food intake (Bevelander et al., 2012; Bevelander, Meiselman, et al., 2013; Romero et al., 2009). There was a significant effect of confederate intake on children's HFHS snack food intake (Z = 5.06, $p < .001$, SMD = 0.48, 95% CI: 0.30, 0.67; Fig. 2), indicating a medium effect.

3.3. Narrative synthesis

3.3.1. Present vs. remote-confederate peers—Seven studies from six articles were included in the narrative synthesis. In the two studies which used a present confederate peer (Bevelander et al., 2012; Bevelander, Meiselman, et al., 2013), the confederate wore a buzzer to indicate when they should eat. The confederate was buzzed immediately after the session had started for high- and low-intake conditions, and every minute in the high-intake condition, and every 3 min in the low-intake condition. Five studies examined the impact of remote-confederate peers on children's snack intake. Three studies exposed children to a fictitious information sheet and a bowl (Sharps & Robinson, 2015, 2017). In the high-intake

condition the information sheet indicated that other children had eaten all of their vegetables, and the bowl contained one carrot to indicate that the previous child had eaten almost all of their vegetables. The researchers left one carrot in the bowl to demonstrate that carrots had previously been in the bowl. In the no-intake condition the information sheet indicated that other children had eaten none of their vegetables, and the bowl was full to indicate that the 'previous participant' had eaten none of their vegetables (Sharps & Robinson, 2015, 2017). One study used the remote-confederate design described above, but also included a no-norm and a control condition (Sharps & Robinson, 2015). The no norm condition showed a fictitious information sheet with the intake column present, but this column did not contain any information and the bowl contained an item unrelated to food (pens). The control condition did not include the intake column but children were exposed to the same bowl as the no norm condition. In all conditions the researcher discussed the information sheet and the bowl with the children to ensure the intake information was clear. Two studies examined the intake of a remote-confederate peer who was visible on a television or computer screen (Bevelander, Anschütz, et al., 2013; Romero et al., 2009). In both studies the remote-confederate peer was visible and the children could see how much the remote-confederate was eating. Romero et al. (2009) compared a high-vs. a low-intake remote-confederate peer, and Bevelander, Anschütz, Creemers, Kleinjan, and Engels (2013) compared high-, low- and no-eating remote-confederate peers. The children were led to believe that the confederate on the screen was taking part in the experiment in an adjacent room.

The type of confederate (present vs. remote) did not affect whether children's food intake was influenced by the confederate's intake: Children were influenced by the confederate peer regardless of whether the confederate was present or remote. However, there was more variation in how much the high-intake confederate peer influenced children's food intake in the present confederate designs than in the remote-confederate designs. In the present confederate studies, exposure to the high-intake confederate resulted in a larger intake (between 27% and 49% more) than exposure to a no-intake confederate, and exposure to the high-intake confederate also resulted in a larger intake (32% more) than exposure to a low-intake confederate. In studies using a remote-confederate design, the high-intake confederate resulted in 53–59% larger intake relative to the no-intake confederate, and in 32% greater intake compared to the low-intake condition.

3.3.2. Intake condition—The amount of food eaten by the high-intake confederate peers differed between the studies and ranged from the high-intake confederate peers eating ten sweets (chocolate covered peanuts) to all of the mini cookies/vegetables. The intake of a low-intake confederate ranged from three sweets (Bevelander et al., 2012) to seven mini cookies (the equivalent of two and a half cookies; Romero et al., 2009). Exposure to a high-intake confederate peer influenced children to eat between 24% and 59% more than exposure to a no-intake confederate peer (Bevelander et al., 2012; Bevelander, Meiselman, et al., 2013; Sharps & Robinson, 2015, 2017), and 27% and 32% more than exposure to a low-intake confederate peer (Bevelander et al., 2012; Romero et al., 2009). While the meta-analysis showed a significant difference between high- and low-intake confederate peers from two studies (Bevelander et al., 2012; Romero et al., 2009), the study which

could not be included in the meta-analysis (Bevelander, Anschütz, et al., 2013) found no significant difference between a high- and low-intake confederate. Two studies examined low-intake compared to no-intake conditions. One study found no significant difference between the two intake conditions (Bevelander et al., 2012), whereas the other study found that children ate a larger amount when exposed to a low-intake than a no-intake confederate peer (Bevelander, Anschütz, et al., 2013).

3.3.3. Food type—Three studies examined children's intake of sweets/candy (Bevelander, Anschütz, et al., 2013; Bevelander, Meiselman, et al., 2013; Bevelander et al., 2012), three examined children's vegetable intake (two in one paper) (Sharps & Robinson, 2015, 2017), and one examined children's cookie intake (Romero et al., 2009) see Table 1. There was more variation in how much the confederate peer influenced children's food intake in studies which gave children sweets/candy, than in studies which gave children vegetables. In the studies where children were given sweets/candy, children ate between 24% and 48% more in the high intake condition compared to the no intake condition, and between 27% and 32% more in the high intake condition compared to the low intake condition. In studies which gave children vegetables, children ate between 53% and 55% more in the high intake condition than the no intake condition.

3.3.4. Prolonged effect of confederate peers—While the majority of studies consisted of a single experimental session (Bevelander, Anschütz, et al., 2013; Bevelander, Meiselman, et al., 2013; Romero et al., 2009; Sharps & Robinson, 2015, 2017), two studies involved two experimental sessions (Bevelander et al., 2012; Sharps & Robinson, 2017). In Study two of Sharps and Robinson (2017), children were either exposed to the remote-confederate (the information sheet and bowl described above) on day one or day two (24-h apart). Children were only exposed to the remote-confederate information on one of the days, but they were given a snack (carrot batons) to eat on both days. In Bevelander et al. (2012), children were exposed to a present confederate peer in the first session and were alone in the second session, approximately 24-h later. In this study, children had access to the same snack as the confederate peer in the first session (chocolate covered peanuts), but they had a choice of six snacks (sweet and savoury) in the subsequent free-eating session. In both studies, exposure to a high-intake confederate in session one influenced children to eat significantly more in a free-eating session than exposure to a low or no-intake confederate in session one.

3.3.5. Moderators

3.3.5.1. Weight-status.: All studies measured BMI; however, two studies specifically examined whether weight-status moderated the influence of a confederate peer (Bevelander et al., 2012; Romero et al., 2009). These studies recruited relatively equal numbers of children with a healthy-weight and children with overweight. Two studies found that children with overweight ate significantly more than children with a healthy-weight (Bevelander et al., 2012; Romero et al., 2009). However only Bevelander et al. (2012) found that weight-status moderated the effect of the confederate intake condition. In this study, children with overweight ate significantly more than children with a healthy-weight when exposed to a no-intake confederate. Furthermore, children with a healthy-weight ate equal

amounts in the low- and high-intake conditions, but ate significantly less in the no-intake condition. In contrast, children with overweight consumed similar amounts in the no-and low-intake conditions, but consumed significantly more in the high-intake condition. Thus, exposure to a no-intake confederate did not curb the intake of children with overweight but appeared to curb the intake of children with a healthy-weight.

3.3.5.2. Self-esteem.: One study examined whether the influence of a confederate was moderated by self-esteem (Bevelander, Anschütz, et al., 2013). Children completed questionnaires to measure their explicit and implicit self-esteem, and their body-esteem. Body-esteem and implicit self-esteem moderated the effect of confederate intake on children's food intake in one study, whereby, children with lower body-esteem followed the intake of the remote-confederate more closely when exposed to a high-intake confederate compared to a no-intake confederate. When removing children who wanted to gain weight, children with lower body-esteem followed the confederate intake more closely when the confederate ate nothing or only ate a modest amount compared to when the confederate ate a large amount. Similarly, children with higher implicit self-esteem modelled the remote-confederate's food intake more closely when the confederate ate nothing or only a small amount than when the confederate consumed a larger amount of food. Explicit self-esteem did not moderate the effect of confederate intake on children's intake.

3.3.5.3. Emotions.: One study examined whether exposure to an emotional manipulation in a film affected whether children were influenced by a present confederate (Bevelander, Meiselman, et al., 2013). Children were exposed to one of three movie clips (happy, sad or neutral) which lasted for approximately 11 min while seated next a confederate. Children were influenced by the intake of the confederate in the happy and sad movie conditions, eating more when paired with a high-intake confederate compared to a no-intake confederate. However, children were not influenced by the confederate in the neutral movie condition.

3.3.5.4. Usual fruit and vegetable consumption.: Across three studies, there was no evidence that usual fruit and vegetable intake moderated the effect of confederate intake (Sharps & Robinson, 2015, 2017).

3.3.5.5. Normative vs. informational social influence.: Two studies examined the mechanisms underlying the influence of remote-confederate peers (Sharps & Robinson, 2017). The first of those studies examined whether children were influenced by remote-confederates due to a desire to fit in, which was coined by Deutsch and Gerard (1955) as normative social influence. In the study, children were led to believe that they were 'especially liked' by their peers, or they were made to feel uncertain about how 'especially liked' they were. Children were then exposed to remote-confederate peers in the form of the fictitious participant information sheet and a bowl as described above. Priming children to feel 'especially liked', or to feel uncertain about how 'especially liked' they were, did not affect whether children were influenced by the remote-confederates.

The second study examined whether remote-confederate peers influenced children's eating behaviour due to being uncertain about how to behave in a situation and looking to others

to determine the appropriate way to behave. This was coined by Deutsch and Gerard (1955) as informational social influence. In this study all children took part in two sessions which were spaced one day apart. Children were either shown a fictitious information sheet which indicates the intake of previous fictitious participants, and a bowl which corroborates with the information sheet in the first session or in the second session. No sheet or bowl were present in the session where children were not exposed to the remote-confederates, however children received a bowl of vegetables in both sessions. Receiving the bowl of vegetables in both sessions allowed the researcher to examine whether children were influenced by the remote-confederate peer in an unfamiliar (session one) and a familiar session (session two). Children were only influenced by the remote-confederate peers when they were exposed to the remote-confederates in the first session, when the context was novel or unfamiliar. Children who saw the remote-confederate peer intake information in the second session were not influenced.

3.3.5.6. Familiarity with the confederate.: Two studies measured the participants' familiarity with the confederate (Bevelander et al., 2012; Bevelander, Meiselman, et al., 2013). In one study (Bevelander et al., 2012), familiarity with the confederate did not significantly correlate with food intake. In the other study (Bevelander, Meiselman, et al., 2013), familiarity with the confederate did correlate with food intake and was controlled for in the analysis. Each present confederate was also only used on one occasion (Bevelander, Meiselman, et al., 2013; Bevelander et al., 2012).

3.3.6. Quality of evidence—Overall, the studies reviewed were well-designed, included cover stories, and showed no demand awareness. However, it is not clear whether all studies directly measured demand awareness. Only one study included a control group (Sharps & Robinson, 2015). No studies involving present confederates included a control condition where the children ate alone, therefore this would be a useful addition in future studies. To avoid a confederate effect in the studies using present confederates (Bevelander et al., 2012; Bevelander, Meiselman, et al., 2013), each confederate only took part in the study once. We inspected funnel plots of the main analysis and for the sub-groups for asymmetry of distribution (which may suggest publication bias) and found no evidence of this.

4. Discussion

Consistent with previous systematic reviews and a meta-analysis of adults and children (Ragelien & Grønhøj, 2020; Stok, de Vet, de Ridder, & de Wit, 2016; Vartanian et al., 2015), we provide evidence that present and remote-confederate peers influence children's food intake. Children ate more when exposed to high-intake confederate peers relative to low- or no-intake confederate peers, and their intake of healthy and HFHS snack food was influenced. There is also evidence that the influence of a confederate peer may persist over a 24-h period. However, caution must be taken when interpreting these results due to the small number of studies included. High heterogeneity in the sub-group analyses ($I^2 > 50\%$) also meant that comparing the sub-groups statistically was not possible. Further research is needed to examine whether weight-status, self-esteem, and emotions moderate the effects of

confederates on children's food intake, and to examine the impact of confederate peer intake over time.

4.1. Theoretical implications

The findings of this systematic review and meta-analysis provide support for the normative model of social influence (Herman et al., 2003). According to the model, people are motivated to eat as much as possible in the presence of palatable food, and may look to situational norms, such as the eating behaviour of others, to determine the appropriate amount to consume in a situation when they are uncertain of how to behave (Herman et al., 2003; Herman & Polivy, 2005). This has been conceptualised by Deutsch and Gerard (1955) as informational social influence. One study included in this review showed that children were only influenced by the intake of remote-confederates when they felt uncertain about how to behave (Sharps & Robinson, 2017, Study two). While other studies included in this review did not directly examine this mechanism, children were in situations which may have been considered unfamiliar to them, such as a laboratory or in a place in the school where they would not normally consume their snacks. Therefore, children may have been uncertain about how to behave and may have relied on situational norms (i.e. the confederates) when they were in the unfamiliar situation.

While this systematic review and meta-analysis does not provide support for normative social influence as an explanation for why children are influenced by remote-confederate peers, only one study included in this review examined this (Sharps & Robinson, 2017, Study 1). The findings of Sharps and Robinson (2017, Study 1) are in contrast to research in adults which showed that adults were more likely to be influenced by the intake of a present confederate peer when they were primed with a desire to affiliate (Robinson et al., 2011). This difference may be due to the type of confederate design used. The study included in this review used a remote-confederate design, therefore, children may not have perceived their eating behaviour to be a way of fulfilling an affiliation goal. However, more research is needed to investigate this in children using both using present and remote-confederate designs.

This systematic review and meta-analysis provides evidence from two studies that the confederate intake in one session continued to influence children's food intake in a free-eating session in the same setting 24-h later (Bevelander et al., 2012; Sharps & Robinson, 2017). Bevelander et al. (2012) suggested that children may internalise the situational norm from the confederate intake session (session one) into a personal norm, and this personal norm may inform their behaviour in that same setting in the second session. This is supported by Sharps and Robinson (2017, study two) who showed that children were not influenced by a remote-confederate when they took part in a free-eating session in session one, followed by a remote-confederate intake session in session two. These findings indicate that children may only be influenced by confederates in a novel eating context (which they have not eaten in previously), and may rely on their personal norms in contexts which they are familiar with. However, this has only been examined in one study using a remote-confederate design, therefore, further research is needed to examine whether this is also the case with present confederates. Furthermore, it is not clear how long personal norms

may persist for, and whether children may be influenced by a confederate in the same setting at a later date, and research is needed to examine this.

An important consideration from this systematic review and meta-analysis is that all of the studies which used present-confederates provided children with HFHS snack foods, whereas three of the four studies using the remote-confederate design provided children with healthy snacks (Sharps & Robinson, 2015, 2017). Therefore, while larger effects were observed for remote-confederates (large effect) than present-confederates (medium effect), and for healthy snack foods (large effect) than HFHS snack foods (medium effect), it is not clear whether the observed difference in effect sizes for the two sub-group analyses may be due to confederate or food type. To gain a greater understanding of this difference in observed effect sizes, further research is needed to examine whether present confederates influence children's vegetable consumption, and to examine whether remote-confederates influence children's HFHS snack food intake.

4.2. Moderators

Studies in this review showed that self-esteem, emotions, and weight-status may be potential moderators of confederate intake on children's food intake. However, the results regarding weight-status were conflicting, with only one of two studies showing that weight-status moderated the effect of confederate intake. Since only one study examined the role of emotions and one study examined the role of self-esteem, further research is needed to examine these factors as moderators of confederate intake.

4.3. Limitations and gaps in knowledge

All of the studies experimentally examined the influence of a confederate on children's food intake for a variety of foods, and were well-designed. However, this systematic review and meta-analysis is not without limitations. First, there were only a small number of studies included in the meta-analysis (six) and the sub-group analyses contained fewer than this. Therefore, while the findings provide insight into the influence of confederates on children's eating behaviour, caution must be taking when interpreting the results. Second, only one study included a control group (Sharps & Robinson, 2015), therefore, it is not possible to determine how much children would have eaten without being exposed to present or remote-confederates. Studies including a control group where participants eat in the absence of present or remote-confederates would be a valuable addition to this research area, and would allow for the examination of how much children's food intake differs when with a high, low or no-intake confederate compared to when eating alone. Third, the studies here examined children's snack food intake and demonstrated that children were influenced by the intake of the confederates for both high (cookies and sweets/candy) and low calorie (vegetables) snack foods in a school or laboratory environment. However, no studies to our knowledge have examined whether children are influenced by confederates for main meals. According to Stok et al. (2016), the effectiveness of social norms may be restricted to the situations in which people eat with their peers. Therefore, understanding whether children are influenced by the intake of confederates in different environments and during different meal times would add to existing theory about when and where peers and confederates influence children's eating behaviour.

5. Conclusions

In conclusion, this systematic review and meta-analysis provides consistent evidence that children are influenced by present and remote-confederate peers' food intake, and there is evidence that the effects of a confederate peer's intake can persist over a 24-h period. Although larger effects were observed for remote-than present confederates, and for children's healthy snack intake compared to their HFHS snack intake, caution must be taken when interpreting these results due to the inability to statistically compare the groups due to high heterogeneity, and the fact that all present confederate designs provided children with HFHS snacks. Therefore, it is not possible to determine whether the confederate or food type may be responsible for the difference in observed effect size. More research is needed to further examine whether children are influenced by confederate peers during main meals, and whether confederate peers continue to influence children's eating behaviour over a longer period of time. Furthermore, research is also needed to gain a greater understanding of the mechanisms and moderators underlying the influence of confederate peers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Data

The data is available in the papers included in this review, and the data used in this review will be made available to authors on request.

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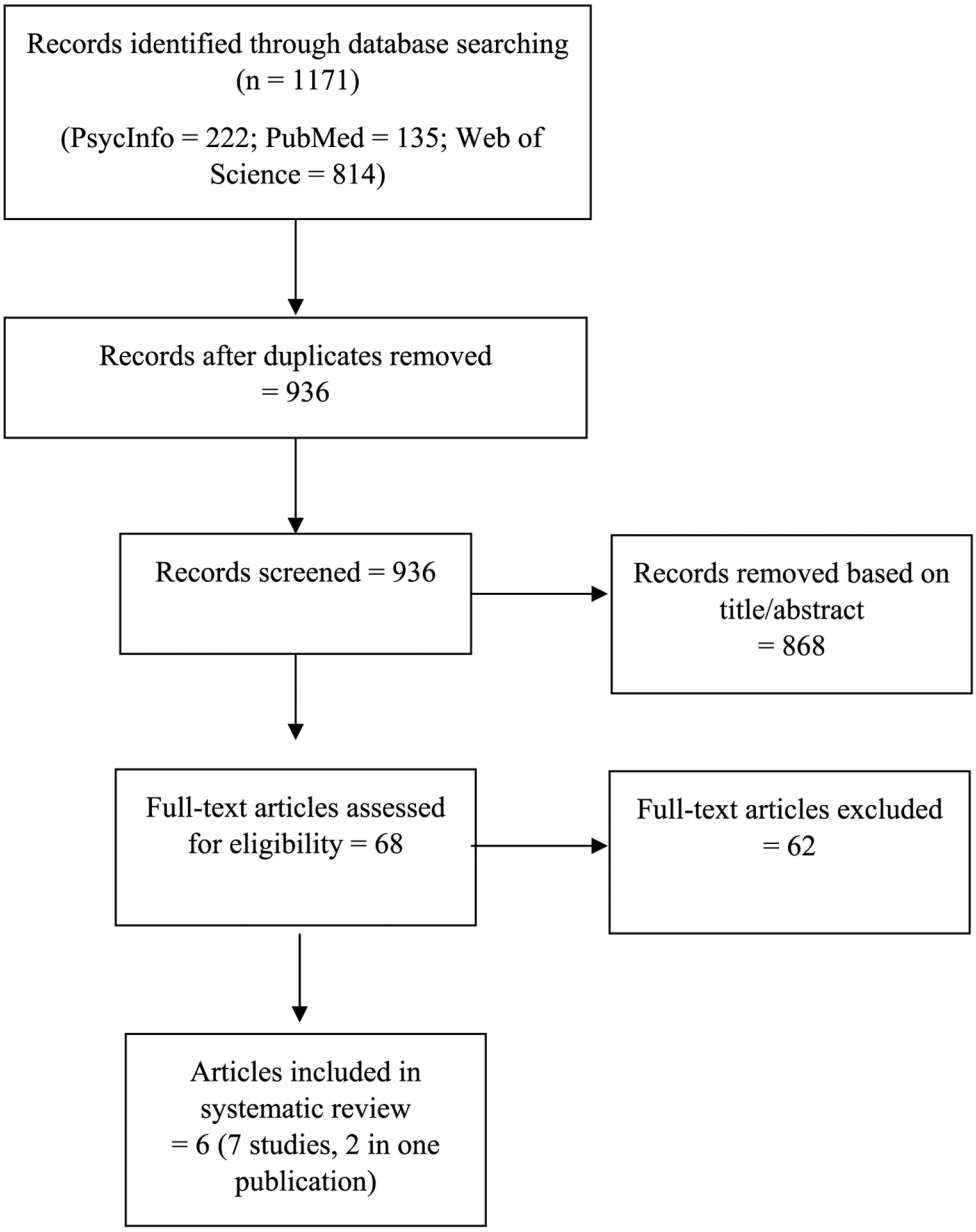

Fig. 1.
PRISMA flowchart.

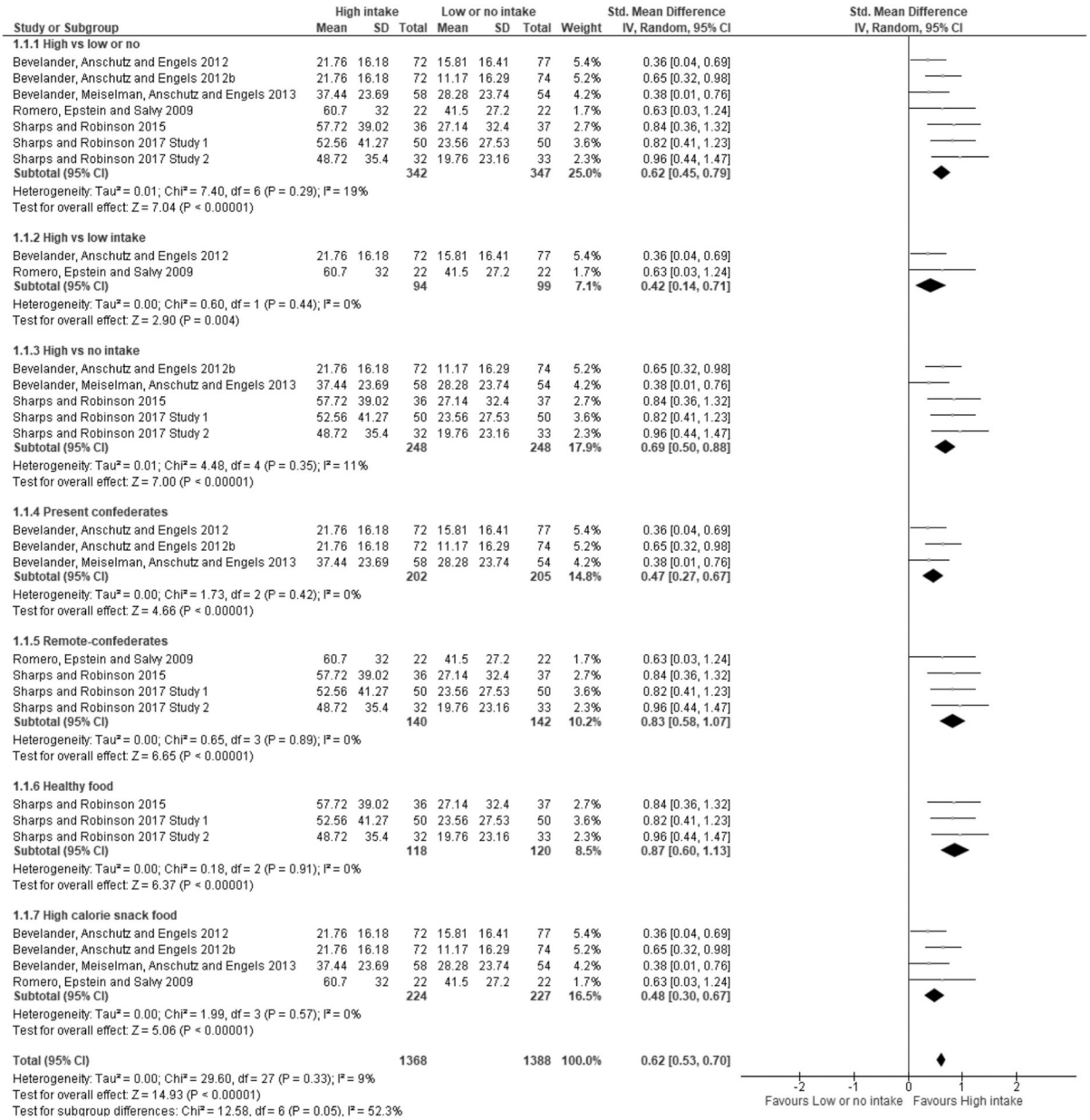

Fig. 2.

Forest plot for experimental studies comparing food intake when participants ate with a high vs. a low or no intake confederate. The forest plot also compares sub-group analyses to compare the influence of high vs. no and high vs. low intake confederates, present vs. remote confederates, and the intake of healthy snacks vs. HFHS snack foods. Total refers to the number of participants. Bevelander, Anschutz and Engels (2012b) refers to a second comparison within the same paper.

Table 1

Study information and methods of selected studies.

Authors (year)	n	Participant age (years), gender, and weight-status	Peer type	Food type	Design	Setting	Cover story	Game/task	Moderators examined
Bevelander et al. (2012)	233	Age = 7–10 years old. Gender = 52% cisboys Weight-status = 65% healthy-weight	Present confederate.	Chocolate covered peanuts	3 (condition: high intake vs. low intake vs. no intake) × 2 (weight-status) between-subjects design. All children were paired with a healthy-weight confederate. Also included a session a day or two later where participants completed the puzzle and ate alone.	Primary school	Children were told that the experimenter was interested in different strategies used to solve a puzzle while working together or alone. The confederates were also told that they would be involved in a secret mission to make even more fun out of the puzzle task, and the experimenters were also interested in whether they could keep a secret while cooperating with someone else.	Puzzle	Weight-status
Bevelander, Anschutz, Creemers et al. (2013)	118	Age = 10–12 years old Gender = 61.9% cisgirls Weight status = 85.6% healthy-weight	Remote-confederate	Chocolate covered rice crispies.	Between-subjects design with 3 conditions (high intake (15 pieces of candy), low intake (4 pieces of candy), control (no intake).	Primary school	Participants were told that the experimenters were interested in computer gaming with another child.	Playing a computer game involving shooting blocks.	Explicit and implicit self-esteem and body esteem.
Bevelander, Meiselman, Anschutz et al. (2013)	112	Age = 10–13 years old Gender = 51.8% cisboys Weight-status = 77.7% healthy-weight	Present confederate	Chocolate-coated peanuts	3 (movie clip: happy vs. neutral vs. sad) × 2 (high intake vs. no intake) between-subjects design	Primary school	Children were told that moviemakers had created a new version of Walt Disney's Bambi, and were interested in the children's evaluations of the movie, and the food and water was there for them if they desired.	Watching a movie clip	Emotional manipulation
Romero et al. (2009)	44	Age = 8–12 years old Gender = cisgirls Weight-status = 50% healthy-weight	Remote-confederate	Mini Oreo bite-sized cookies.	2 (intake: high vs. low) × 2 (weight-status: healthy weight vs. overweight) between-subjects design.	Laboratory	Children were told that the researchers were interested in how they completed a task and were told to help themselves to cookies while they did the task. They were told that the video confederate was another participant taking part.	Sorting pictograms of different activities	Weight-status
Sharps and Robinson (2015)	143	Age = 6–11 years old Gender = 51% cisgirls Weight-status = 89% healthy-weight.	Remote-confederate	Raw carrot batons	Between-subjects design with four conditions (high intake vs. low intake vs. no intake vs. control)	Primary school.	Children were told the researcher was interested in how children play games.	Animal pairs game	Usual fruit and vegetable consumption
Sharps and Robinson (2017) study one	100	Age = 6–11 years old Gender = 53% cisgirls Weight-status = 88% healthy-weight	Remote-confederate	Raw carrot baton	2 (remote-confederate: high intake vs. low intake) × 2 (social acceptance: accepted vs. uncertain) between-subjects design.	Primary school	Children were told the researcher was interested in how children play games.	Animal pairs game	Usual fruit and vegetable consumption

Authors (year)	n	Participant age (years), gender, and weight-status	Peer type	Food type	Design	Setting	Cover story	Game/task	Moderators examined
Sharps and Robinson (2017) study two	127	Age = 6–11 years old Gender = 54.3% cisgirls Weight-status = 82.7% healthy-weight	Remote-confederate	Raw carrot batons	2 (remote-confederate: high intake vs. low intake) × 2 (familiarity of eating condition: familiar vs. unfamiliar) × 2 (eating session: session one and session two) mixed design.	Primary school.	Children were told the researcher was interested in how children play games.	Animal pairs game	Usual fruit and vegetable consumption