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The Effectiveness of Museum Intervention on Parent–Child Conversations: A Meta-Analysis

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ABSTRACT

Museums offer great potential for learning, mediated by parent–child conversations. Despite much qualitative research conducting informative observations of family museum interactions, limited experimental work has investigated how to maximize these experiences. Recent studies have begun to quantitatively examine the potential of researcher-facilitated and resource-based interventions to enhance parent–child conversation in the museum context. This meta-analysis synthesized data from all identified experimental studies in this emerging field (n = 9, k = 111). Findings suggest that museum interventions significantly improve parent–child dyadic conversations (g = .43, p < .001). Sub-analyses showed that the most successful interventions were those which targeted parents (rather than the parent–child dyad) and explicitly guided parental use of conversational strategies. Implications for practice are discussed.

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Introduction

Museums are unique informal educational environments that provide designed spaces and curated experiences intended to encourage visitors in learning together (Brown et al., 2019; Crowley & Callanan, 1998). Social learning theory suggests that optimal child learning will occur when parents and children *interact* around museum displays and resources (Allen, 2002). This notion of interactive learning is supported by research conducted in both formal education contexts and home environments. For example, evidence suggests that adult support for child-led playful learning can promote richer conversations, greater enjoyment, and increased learning than either free play or direct instruction (Eason & Ramani, 2020; Fisher et al., 2013; Weisberg et al., 2013).

Many museums are designed to support joint participation and to "jumpstart" family conversations (Leichter et al., 1989), in which both the content *and* the strategies used moderate the learning that emerges (Hohenstein & Tran, 2007; Tare et al., 2011). Extensive observational research has provided valuable insight into how families

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naturally interact and learn in museums and identified several prominent conversational strategies: connecting personal experiences (e.g., Callanan et al., 2016; Zimmerman et al., 2010), domain-specific language (e.g., Kelly et al., 2022), questions (e.g., Hohenstein & Tran, 2007), explanations (e.g., Tare et al., 2011), and joint engagement (e.g., Fender & Crowley, 2007; Tessler & Nelson, 1994).

However, such studies forgoing control groups and random assignment fall short of investigating causation (Fender & Crowley, 2007). As such, little is known about how to *support* interactions and conversations in museums. Research suggests that parents are open to, and benefit from, museum guidance (Dierking & Falk, 1994; Song et al., 2017), but there is limited evidence on whether interventions can shape parent–child interactions and, if so, which features are most effective. In response, by employing experimental designs, the field can better understand how to prompt conversations. Fortunately, a recent shift in museum research from exploratory to experimental (Falk, 2004) has begun investigating these questions, making the last twenty years uniquely prolific and its review timely. This study aims to examine existing quantitative experimental evidence to determine the ability of interventions to support parent–child conversations during museum visits.

Supporting parent–child museum conversations

Theory and evidence suggest that *conversation* might serve as the principal mechanism for learning in the museum context (Ash, 2003; Fender & Crowley, 2007; Haden, 2010). Social interactions are fundamental to development (Vygotsky, 1986), and "language always mediates" (Hasan, 2012, p. 88) learning. Language exposure, which has been shown to differ with socioeconomic status, and child conversational turns are influential factors (Romeo et al., 2018). Over and above the effects of participation, the *quality* of conversation is also important (Hohenstein & Tran, 2007; Zauche et al., 2016). Clearly, conversation is powerful, but previous research has indicated that, on their own, parents may not fully exploit it to explain and explore exhibits for deeper museum learning (Fender & Crowley, 2007; Zimmerman et al., 2010).

A wealth of evidence shows that facilitating parent–child "guided play" can significantly improve the quality of parent–child conversation (Eason & Ramani, 2020; Ferrara et al., 2011). In addition, explicitly instructing mothers on conversational content and strategies has resulted in greater incorporation during at home activities (Boland et al., 2003; Vandermaas-Peeler et al., 2012). Moreover, various tools (e.g., signs, games, books) can improve conversation and support learning goals during everyday activities (Hong et al., 2018; Ridge et al., 2015).

The success of guidance and support for parent–child interactions extends to the museum environment. In fact, parents have reported that museum activities help them learn how to support their child's learning (Letourneau et al., 2021). Prior research has demonstrated that museum staff can increase visitors' participation and engagement, as well as initiate deeper exhibit-focused conversations (Boisvert & Slez, 1995; Kopczak et al., 2013; Rosenthal & Blankman-Hetrick, 2002). It is clear that parent–child interactions and conversations can be influenced; however, research also suggests that the *type* of scaffolding matters. Families with enhanced museum visits (e.g., supplemented

with child-friendly activities) engage with exhibits for longer and produce more learning conversation, but such outcomes are sensitive to the enhancement type and/or delivery (Borun et al., 1997; Tenenbaum et al., 2010). Concrete evidence on *how* to support parent–child conversations in the museum environment would thus help visitors tap into museums' full educational potential.

A focus on parent–child dyads

Museum visits take place in a variety of family groupings. Despite this, evidence suggests that visiting groups tend to divide themselves (Ash, 2003), often into parent–child pairs (Erätuuli & Sneider, 1990). This may naturally support on-topic engagement (Allen, 2002), as children benefit from greater parental attention and support, personalized teaching and instruction, and more positive affect during dyadic activities than when in multi-sibling groups (Benigno & Ellis, 2004; Finn & Vandermaas-Peeler, 2013). Evidence also suggests that adult-child conversations result in deeper exchanges and more scaffolding than peer-to-peer or sibling-to-sibling (Imberi-Olivares, 2009). As such, many museums have shifted their focus from individual engagement toward parent–child interactions (Rogoff et al., 2016).

The high interactivity between parents and their child(ren) means a robust shared history from which to exchange ideas and build meaning (Daniels, 2001; Rogoff et al., 2016). Ethnographic museum research has found that families spontaneously discuss their past experiences (e.g., prior vacations, video games, television shows, parent's jobs) to bring understanding to complicated exhibit subjects (e.g., biology) (Zimmerman et al., 2010)—and the more concrete past references are, the more likely children are to acquire abstract concepts (Crowley et al., 2001). Facilitating between the museum and their child, the parent acts as a personal "explainer", (Crowley & Callanan, 1998; Crowley et al., 2001), supported by their use of conversational strategies (Callanan et al., 2016; Carr, 2003).

Although recognizing the value of sibling and family-group interactions, this study focuses on parent–child *dyads*. This is considered an important first step in examining the potential for museum interventions, before extending out to the complexity of multi-person interactions. The lower age limit of "child" in this review is 3 years, to exclude confounding outcomes with pre-verbal children. The upper age limit is 10 years, informed by numerous children's museums that end their target audience at age 10, indicating a potential change in museum approaches (e.g., child engagement, parental support) for older children.

Parent-child museum conversations

To fully inform the design of conversation-focused museum interventions, it is important to establish what makes parent–child conversations beneficial and why. Children need to be exposed to language to use and profit from it (Zauche et al., 2016)—the greater the input, in quantity *and* quality, the better their language learning, aptitude, and usage (Rowe, 2012). Such conversational modeling has been widely observed in museums, where parental usage of causal statements has predicted child's causal

statements (Callanan et al., 2020) and parent explanatory utterances have been associated with child explanatory utterances and exhibit-content statements (Tare et al., 2011). This pattern extends to domain-specific language, the subject-matter of conversation (e.g., spatial talk, engineering talk). For example, children of parents who use more science language during aquarium visits also use more science language (Kelly et al., 2022). Furthermore, longitudinal research indicates that parents' domain-specific language not only influences children's same domain language, but also their corresponding domain proficiency (Pruden et al., 2011). This is promising for museum education because it suggests that helping parents enhance their conversational output (amount and content) and encouraging conversations to be "museum-focused" might heighten the impact of exhibit exploration.

Another important conversational element is well-formed questions. Questions prompt and support children in the discovery, explanation, justification, and comprehension of new understandings (Bell et al., 2009; Carr, 2003; Honomichl & Chen, 2012). It is unsurprising, therefore, that "questioning is widely regarded by educators as one of, if not the, central inquiry behaviors that support learning in informal environments" (Bell et al., 2009, pp. 144–145). Simply adding guiding questions to museum exhibits increases within-family question-asking and subsequent child learning (Hohenstein & Tran, 2007). Moreover, families better enjoy, participate, and solve for unknown knowledge when approaching exhibits with a "juicy question" (Gutwill & Allen, 2010). Thus, supporting parents to ask questions during museum visits may help children engage more deeply and emerge with higher-level understandings.

Parent-child conversations are also influenced by joint talk, where both the parent and child are engaged and responsive. In fact, three-year-olds from mother-child pairs perform best on memory tasks in the home and museum environments when high joint talk is established (Hedrick et al., 2009; Tessler & Nelson, 1994). Moreover, parent–child dyads with greater conversational turn-taking, stemming from increased parental engagement, held less misconceptions while completing museum exhibit activities together (Shtulman & Checa, 2012). In sum, the parent's role in conversation is critical, and museums can, and do, evoke greater child outcomes when engaging the parent and child as joint participants in high-quality, exhibit-focused conversation.

Features of museum intervention design

Museum learning conversations are as multi-faceted as the design features that promote them (Degotardi et al., 2019). While museums have developed many shared strategies to support visitors (e.g., signage, demonstrations, and docents) (Rennie & Johnston, 2004), interventions vary in design. It is important to know more about which features most effectively support parent–child conversations.

The first factor is who the intervention targets. Some target the parent, with the aim of supporting them as a mediator between the environment and their child (Crowley & Callanan, 1998), while others target the parent–child dyad as a unit. Secondly, interventions vary in their means of support. Approaches can be divided into those which rely on physical resources (e.g., activity guides, signage) to scaffold experiences, and those which rely on museum staff as facilitators (Hooper-Greenhill,

1994). Thirdly, museum interventions vary in the explicitness of their support for parent–child conversation. Some (e.g., Pagano et al., 2020) provide engaging, goal-driven activities, which, in turn, influence conversations, while others (e.g., Vandermaas-Peeler et al., 2016) explicitly target conversation-supporting behaviors through training and/or prompting.

Having a clearer understanding of the differential impact of intervention design features will allow museums to be more effective in providing support for parents. Such knowledge is essential because without, "helping the helpers, the energy and resources devoted to deepening museum learning may be wasted, or at best, under-exploited" (Schauble et al., 2002, p. 449).

The current study

This study aims to fill a gap in current knowledge regarding the potential for museum interventions to support parent–child conversations, to extend research knowledge, and to suggest practical guidance for museum design. Although the diverse outcomes of previous studies accurately reflect the multi-faceted nature of museums (Boisvert & Slez, 1995), this diversity—alongside their small scale—makes it challenging to draw concrete conclusions from any individual study. This study serves as the much-needed quantitative synthesis in a broad and growing field, and augments the rich qualitative work. It aims to examine existing evidence by conducting, to the best of our knowledge, the first meta-analysis of experimental museum intervention research, with a focus on supporting parent–child conversation. It addresses the following questions:

RQ1: Are museum interventions effective at improving conversation outcomes in parent–child dyads?
RQ2: Do museum interventions have a greater effect on parent outcomes, parent–child joint talk outcomes, or child outcomes?
RQ3: Do museum interventions have a greater effect on museum-focused ('on-topic') conversation or on general parent–child conversation?
RQ4: Do the effects of museum interventions vary by intervention design? For example:
- *whether they target the parent or the parent–child dyad;*
- *whether they are researcher-facilitated or resource-based;*
- *whether they explicitly target conversational strategies or take an implicit approach.*

Based on previous evidence, it is expected that museum interventions will have a positive overall effect on parent–child dyadic conversations (RQ1). It is hypothesized that the largest effect will be seen for parent outcomes, since change in parent behavior precedes child changes (RQ2). It is also hypothesized that interventions will increase museum-focused conversation more than general conversation (RQ3), given their alignment with museum goals. Finally, reflecting the importance of high-quality parent–child interactions, it is hypothesized that who interventions target and whether they explicitly target conversational strategies will have greater differential impacts on parent–child conversation than whether they are presented as researcher-facilitated or resource-based (RQ4).

Method

Working definitions

Informed by Falk and Dierking (2011), the term "museum" is used to denote an "informal educational institution" (p. 1), including museums *and* similarly learning-focused environments (e.g., science centers, zoos, aquariums). The term "intervention" is used to denote anything the museum has provided additional to or different from a typical experience, with the aim of encouraging parent engagement with their child.

Eligibility criteria

For inclusion, studies had to:

1. be conducted in a museum, as operationalized above
2. focus on children aged 3–10 years
3. investigate parent–child conversation as an outcome
4. focus on dyads of one child with one parent/caregiver
5. employ an experimental design with a between-subjects intervention and best effort to randomly assign dyads
6. assess an intervention group(s) against a control group interacting in the same exhibit space
7. contain enough information to calculate effect sizes for all conversation measures
8. be in English
9. be published 2000–present
10. be a peer-reviewed article or dissertation.

Literature search

The literature search was conducted in May 2019 on three databases chosen for their relevance to child development and education research: *PsycInfo* accessed via the Ovid platform, *BEI (British Education Index)* via EBSCO, and *ERIC (Education Resources Information Center)* via EBSCO and ProQuest. The protocol to search *ERIC* on two hosting servers was chosen after discovering a slight discrepancy between results—including both ensured identifying all studies.

The terms in Table 1, inclusive of Boolean operators, were used with the default settings of each search engine. To maintain breadth, only the 2 most defining characteristics were included in the terms: the participants and the environment. Initial searches yielded 2,938 results. The databases' time range filter was used with the targeted timespan, collectively returning 1,775 results. After removing duplicates, 1,315 abstracts were screened. Full papers for 100 results were retrieved, with 8 meeting all criteria. For 4 studies, which had ambiguity or insufficient data, researchers were contacted. This led to one further paper meeting all criteria, resulting in nine studies identified for this meta-analysis (Figure 1). A follow-up search in December 2020

Table 1. Literature search terms.

Justification	Search terms
Necessitates at least one term relating to the dyad formed in parent–child interactions	*("parent*-child*" OR "caregiver*-child*" OR "parent direct*" OR "caregiver direct*" OR "parent guided" OR "caregiver guided" OR "mother*-child*" OR "father*-child*" OR "dyad*")*
Requires both key characteristics	AND
Necessitates at least one term relating to informal educational environments with designed spaces	*("informal" OR "out of school" OR "experiential" OR "hands-on" OR "museum*" OR "zoo*" OR "science hall*" OR "galler*" OR "aquarium*" OR "botanical garden*" OR "nature park*" OR "science center*" OR "science centre*" OR "nature center*" OR "nature centre*" OR "discovery center*" OR "discovery centre*" OR "learning center*" OR "learning centre*")*

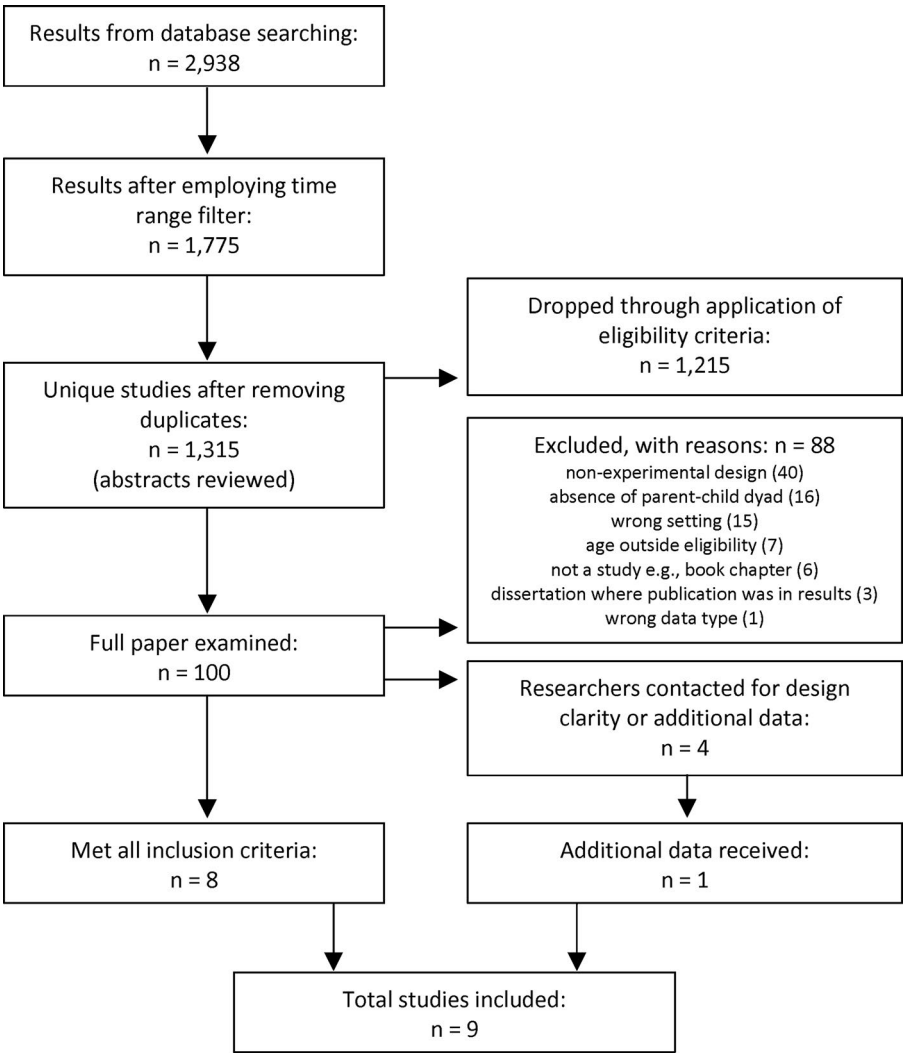

Figure 1. Flowchart of identifying studies for inclusion.

yielded no new results for this study's inclusion. An overview of the studies is provided in the Appendix.

Coding

For each paper, all dependent variables measuring conversation were recorded. Where there was more than one intervention in a study, each was coded independently against the comparison group. Despite potential problems of dependency from using the same control group as the comparison for several interventions (Scammacca et al., 2014), selecting one trial per study—or combining intervention groups—risks excluding important variables of influence (Higgins & Green, 2008). Given the goal of providing best practice guidance by studying potential moderators, it was considered essential to retain all information on variations between interventions. However, in two studies not all conversation outcomes were extracted because nesting issues would have double counted data. In one (Polinsky et al., 2017), 8 specific spatial term categories (e.g., shape, patterns) were forgone in favor of a provided composite spatial term measure. In another (Eberbach & Crowley, 2017), an overall conversational strategy measure was forgone in favor of individual strategies (e.g., *wh*-questions, positive feedback). These levels were chosen for being more aligned with other studies, making them better suited for meta-analytic comparison (Lipsey & Wilson, 2001). This process resulted in 113 outcome variables from 18 interventions.

Effect sizes

Standard mean difference effect sizes were calculated as Hedge's *g*, on the basis of its suitability for smaller sample sizes (Hedges, 1984). A check for outliers resulted in the removal of two effect sizes (4.72 and 5.22), reducing the total to $k = 111$, the final sample size.

Type of outcome

To gauge the impact of intervention on parent, child, and joint outcomes (RQ2), each dependent variable was dichotomously coded three times: whether it was a measure of (1) only the parent or not, (2) only the child or not, and (3) joint talk or not.

To evaluate whether effects varied by conversational content (RQ3), a fourth dichotomous code was applied to indicate whether the dependent variable was a measure of on-topic conversation (e.g., number of spatial terms, parent elaborative talk: target objects) or general conversation (e.g., total utterances, parent elaborative talk: nontarget objects).

Intervention features

Each effect size was dichotomously coded on 3 features (RQ4): whether the intervention (1) targeted the parent or the parent–child dyad (2) involved interaction with a researcher or was purely resource-based (3) explicitly targeted conversational strategies (e.g., instructing parents to ask questions) or was based around the exhibit topic (e.g., an engineering demonstration).

Inter-rater reliability

Three studies (33.33%) were randomly selected, totaling 24 effect sizes (21.43% of sample size), and coded by a second researcher for the 4 "types of outcome" and the 3 "intervention features" for a total of 168 comparisons. The Cohen's kappa was .93, reflecting almost perfect agreement.

Publication bias

To examine the risk of publication bias, an Egger's test of asymmetry was run with standard error as the predictor. The results (z = .81, p = .417) indicated no significant risk of publication bias.

Analysis

Analyses were carried out with RStudio (Version 1.2.1335) (RStudio Team, 2018). The metafor package, in particular, the rma.mv function (Viechtbauer, 2010), was used because it is a random-effects multivariate model, recommended for synthesizing dependent effect sizes (Assink & Wibbelink, 2016), as more than one effect size was extracted from each study.

Tests were conducted to ascertain the overall effect size, evaluate subgroups, and examine moderators. Firstly, one meta-analysis was run with all of the effect sizes to determine the overall impact of museum interventions on conversational outcomes. Secondly, subgroup analyses investigated how different qualities of the outcome measurements were influenced by intervention. Thirdly, subgroup meta-analyses and meta-regressions determined moderators' influence.

Results

Overall intervention effect

An overall analysis aggregated all effect sizes to answer whether museum interventions are effective at improving conversation outcomes (RQ1). In total, interventions have a moderate, statistically significant positive effect on parent–child conversation outcomes g = .43 ([95% CI .20, .65], SE = .11, p < .001). The test of heterogeneity was statistically significant (Q(110) = 427.30, p < .0001), indicating more variance could be accounted for in the subsequent steps.

Effective interventions

The interventions that resulted in the largest increase of parent–child conversation outcomes were those which gave parents prompt cards focusing on domain-specific language (e.g., numeracy, shape-language) (Braham et al., 2018; Polinsky et al., 2017) and when researchers or written resources asked and/or gave samples to parents to incorporate conversational strategies (Benjamin et al., 2010; Eberbach & Crowley, 2017; Jant et al., 2014; Willard et al., 2019). The data suggests that explicitly prompting

Table 2. Outcome measure meta-analysis results.

Subgroup	k	*g*	95% CI	SE	*p*	*Q*
Speaker						
Parent	54	.55	[.19, .91]	.18	.004	251.56
Child	41	.23	[.04, .43]	.10	.022	80.59
Joint	16	.78	[.15, 1.41]	.29	.018	71.13
Exhibit subject content						
Yes	70	.72	[.29, 1.15]	.22	.002	324.35
No	41	.20	[−.05, .45]	.13	.118	74.82
Overall	111	.43	[.20, .65]	.11	<.001	427.30

explanations might be less effective than other conversational strategies (e.g., *wh*-questions, associations). Exhibit signage, though overall not as effective, only appears effective when including conversational prompts/questions alongside exhibit explanations (Kim, 2009). Supporting dyadic joint attention was more effective than supporting exploration (Povis & Crowley, 2015; Willard et al., 2019). Finally, demonstrations seem ineffective at increasing parent–child conversation (Benjamin et al., 2010; Marcus et al., 2017). The following analyses offer quantitative information to help identify what it is that might make interventions differentially effective in practice.

Subgroup analyses

Due to the variety of conversational measures captured in museum settings, it was determined that subgroup analyses would provide greater insight into how interventions influence these dyadic conversations. Results are presented in Table 2.

To determine for whom interventions are most effective (RQ2), a subgroup analysis was run for each categorization of "speaker": parent (k = 54), child (k = 41), and joint talk (k = 16). There was a significant increase in output for all three. Intervention had the largest effect on joint talk measures (g = .78, p = .018), a moderate effect on parent output (g = .55, p = .004), and a small effect on child output (g = .23, p = .022).

To answer whether intervention effects varied by the content of conversations (RQ3), subgroup comparisons determined that on-topic (k = 70) conversation significantly increased with a marginally large effect size (g = .72, p = .002), while general statements (k = 41) were not significantly impacted (g = .20, p = .118).

Moderator analyses

To determine whether the effects of museum interventions vary by design (RQ4), moderator analyses explored intervention features. Meta-analytic effect sizes are presented in Table 3 and meta-regression results in Table 4.

The effect size was greater for interventions that targeted just the parent (k = 36, g = .70, p < .001) than those that targeted the parent–child dyad (k = 75, g = .25, p = .017). A meta-regression found the difference significant (b = .44, p = .008).

While the effect of resource-based interventions was significant (k = 79, g = .44, p < .001), that of researcher-facilitated interventions was not (k = 32, g = .42, p = .132).

Table 3. Intervention feature meta-analysis results.

Subgroup	k	*g*	95% CI	SE	*p*	*Q*
Who is targeted						
Parent	36	.70	[.37, 1.03]	.16	<.001	181.44
Dyad	75	.25	[.05, .46]	.10	.017	207.73
Researcher-facilitated						
Yes	32	.42	[−.13, .97]	.27	.132	185.03
No	79	.44	[.21, .67]	.12	<.001	241.16
Explicitly targeted conversation						
Yes	61	.58	[.32, .84]	.13	<.0001	232.15
No	50	.25	[−.04, .55]	.15	.088	153.75

Table 4. Intervention feature meta-regression results.

Feature	*b*	95% CI	SE	*p*
Who is targeted				
Intercept	.24	[−.001, .47]	.12	.051
Parent	.44	[.12, .76]	.16	.008
Researcher-facilitated				
Intercept	.41	[.15, .67]	.13	.002
Yes	.07	[−.31, .44]	.19	.724
Explicitly targeted conversation				
Intercept	.21	[−.04, .46]	.13	.100
Yes	.40	[.15, .65]	.13	.002

However, a meta-regression showed no statistically significant difference (b = .07, p = .724).

There was a significant effect when conversational guidance was explicitly incorporated into the intervention (k = 61, g = .58, p < .0001), but not when interventions did not explicitly encourage a specific form of conversation or strategy (k = 50, g = .25, p = .088). A meta-regression verified the difference was significant (b = .40, p = .002).

Discussion

This meta-analysis has, to the best of our knowledge, been the first to quantitatively review the emerging field of museum experimental studies. It has done so by examining the effectiveness of museum intervention on parent–child dyadic conversations. The overall positive effect size indicates a global post-intervention increase in dyadic conversation measures, providing evidence that museum interventions can successfully enhance parent–child conversation (RQ1). This echoes findings from informal and home environments (e.g., Boland et al., 2003; Ridge et al., 2015; Vandermaas-Peeler et al., 2012), suggesting a potential opportunity to share mediation techniques. Subgroup and moderator tests offer valuable guidance for practice.

Intervention influence

The results indicate that interventions significantly increase the outcomes for all three speaker classifications (RQ2). It is notable that the largest increase was in joint talk. As previous research has illustrated that learning stems from joint talk (Hedrick et al.,

2009; Tessler & Nelson, 1994), this finding speaks encouragingly to the notion that interventions could aid visitors in museum learning. That effects were greater for parent than child outcomes could be a function of the fact that conversational input is a catalyst in changing children's output (Romeo et al., 2018; Rowe, 2012). In all, these findings support social learning theory and suggest that museums focus on supporting parents in conversing with their child.

Findings also indicate that interventions significantly increase the amount of on-topic, but not general, conversation (RQ3)—that is, conversations become more museum-focused. Prior research shows that increases in domain-specific conversation are associated with increases in same domain performance (Pruden et al., 2011). Taken together, this suggests promise for museum interventions in enhancing children's exhibit-topic learning.

Intervention design

As previous research suggested that the *type* of visit enhancement impacts outcomes, moderator analyses offer important insight for optimizing museum practice (RQ4). Interventions were more effective when targeting the parent rather than the dyad. This is plausible, and helpful, if the parent is truly acting as a guide or mediating agent between the museum and child (Crowley & Callanan, 1998; Rogoff et al., 2016). Secondly, interventions that explicitly guided parents in conversational strategies were more effective than those that did not. Therefore, if museums want to mobilize parents as their child's conversational guide, interventions should be designed to explicitly support conversation strategies.

Conversely, mode of delivery was not a significant moderator. The lack of increased benefits from researcher-facilitated interventions is noteworthy, indicating that intelligent implementation of resource-based approaches to support parent–child conversation may allow museums to reserve limited staff for other facilitation efforts. Moreover, previous research has shown that parents offer more guidance when learning opportunity is more apparent (Bjorklund et al., 2004). That parent–child conversations benefit from resource-based approaches as much as researcher facilitation indicates that parents have these skills and, rather than needing to be taught conversational strategies, merely need prompting that museums are places to employ them.

Contributions

Museum interactions and outcomes are influenced by various characteristics of the setting and experience (Falk, 2004; Letourneau et al., 2021). While the high heterogeneity of the overall analysis reflects this, it is unlikely for any one study to examine the effects of all museum intervention features. As a result, a review such as this is the best way to answer the present research questions. The use of a random-effects model allowed this study to capture multiple interventions and/or effect sizes from each identified study, enabling rich comparison and highly informative subgroup and moderator analyses. As the field expands, the present methodological framework offers an outline for future investigations.

It is possible to credit *contribution* of museum practices toward outcomes (Preskill, 2011). By only including experimental research conducted in museums, some ecological validity is maintained; as such, these studies generally reflect the conversational patterns observed in family museum interactions. By only including experimental studies, causation can be considered (Morrison, 2009). As such, this study provides practical information for museum educators. It has argued for museums to support parents by elucidating the benefits of high-quality parent–child conversation. Further, the findings offer instrumental quantitative guidance on how to do this, which supplements existing in-depth qualitative museum research to comprehensively inform best practice. In all, these results suggest that to prompt families' conversations, best practice interventions would be those which focus on parents (rather than parent–child dyads) and provide explicit guidance on conversational strategies.

Limitations and future directions

This study suffers a number of limitations. Due to the infancy of the field, the most obvious is the small sample size. Additionally, the field's diversity, without yet having agreed definitions on terms, presents a chance of not having captured all studies, even with careful attention to include a diversity of search terms. Though the null finding of publication bias and the results' moderate magnitudes indicate it is improbable that enough unpublished and/or unidentified studies exist (Rosenthal's Fail-safe $N = 8121$) for the findings to lose significance (Lipsey & Wilson, 2001), it must be considered. Furthermore, by artificially influencing the museum experience, it inherently changes (Falk et al., 1986). The focus on experimental designs, while important for this article's purpose, might eclipse important factors in spontaneous interactions captured using other methodologies (Fender & Crowley, 2007; Rennie & Johnston, 2004).

Another key limitation stems from the fact that families who choose to visit museums tend to be distinct from those who do not (Bell et al., 2009), and museums have differential meanings and effects on visitors of varying backgrounds (Falk, 2004; Rogoff et al., 2016). However, "much research and evaluation data from informal places of learning have been based on educated, middle-class, European-American families" (Ash & Lombana, 2013, p.72), a trend that was echoed as a limitation in papers meeting inclusion criteria. Moreover, all eligible studies were from the United States of America. Since museum learning is individualized (Rennie & Johnston, 2004) and families from different backgrounds interact within it differently (Fasoli, 2014), museums need to cater to diverse needs (Brown et al., 2019). Therefore, to inform inclusive environments, future museum intervention studies need to include more diverse samples and, meanwhile, museums should adopt present findings mindfully.

Despite limitations, this study has demonstrated that museum interventions have potential for improving parent–child dyadic conversations. As such, they are a promising area to invest future resources in development and evaluation. Future research should focus on how interventions can best improve conversational *quality,* above and beyond quantity. Further, as different conversational strategies (e.g., questions, explanations, associations) are theoretically distinct in use and function, it would be helpful

to investigate their differences as the field grows, in both influence and malleability. While acknowledging that these implications differ, the existing body of work did not offer enough examples of each to make this investigation practical.

Additionally, while within-group conversations are instrumental during museum visits, visitors are also affected by interactions with out-of-group others (e.g., explainers, demonstrators, guides) (Falk, 2004). However, just as internal museum evaluators might be less practiced than external evaluators (Diamond, 1999), museum staff might be less adept than researchers at facilitating interventions. While museum educators *do* play a key role in facilitation (White et al., 2021), further research should investigate child-museum staff interactions and whether staff members are as effective as researchers in presenting interventions.

Lastly, there is more for the field to understand about the child learning and cognitive gains that might stem from improved parent–child conversations in the museum setting, completing the theory-of-change cycle. Future experimental studies on parent–child museum interventions should extend its scope to include measures assessing the effect on child learning outcomes, both the extent to which knowledge learning occurs and whether lasting gains and transfer can be detected outside the museum.

Conclusion

Museum visitors are, "under no obligation whatsoever to learn anything" (Serrell, 1997, p. 109). Despite this, learning does occur during museum visits, and "what the cumulative result of these experiences will be is up to future exhibition designers and museum educators working together and with their audience" (Hein, 1998, p. 179). The results of this study suggest that museum parent–child conversations, a significant mediator of learning, can be thoughtfully enhanced with appropriate intervention. Further, they offer concrete best practice recommendations regarding what "thoughtful design" might mean in this context: interventions focused on explicitly supporting parental conversation. While effect sizes were largely moderate, the infancy of the field suggests further research and synthesis as this promising area continues to unfold.

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An asterisk indicates a study's inclusion in the meta-analysis.

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Appendix

Study summaries

Title	Source (year)	Author	Child Age Range in Years (mean, if provided)	Location	• Dependent Variables	Intervention Summaries
Enhancing building, conversation, and learning through caregiver–child interactions in a children's museum	Developmental Psychology (2010)	Benjamin et al.	4.00 – 8.90 (6.60)	children's museum	• caregiver's *wh*-questions • caregivers' associations • child's *wh*-questions • children's associations • children's responses • % of caregiver's *wh*-questions with engineering content • % of children's responses with engineering content	1: Pre-exhibit researcher presentation of structural engineering principles, and adults instructed on using *wh*-questions and bridging statements. 2: Pre-exhibit researcher presentation of structural engineering principles. 3: Pre-exhibit adults instructed on using *wh*-questions and bridging statements. 4: Pre-exhibit decoration of previous participants' towers.
Children's spontaneous focus on number before and after guided parent–child interactions in a children's museum	Developmental Psychology (2018)	Braham et al.	2.97 – 5.27 (4.14)	children's museum	• parent total utterances • child total utterances • parent mathematical number words • child mathematical number words	1: Importance of early math skills highlighted and parents given prompt card to focus on costs and shopping on a budget.
From seeing to observing: how parents and children learn to see science in a botanical garden	Journal of the Learning Sciences (2017)	Eberbach & Crowley	6 – 10 (8.25)	botanical garden	• parental *wh*-questions • parental child focused comments • parental linking to prior experience • parental positive feedback • disciplinary talk	1: Parents provided pamphlet, 12-minute DVD, and researcher clarifications on elaborative conversational strategies.
Conversation and object manipulation influence children's learning in a museum	Child Development (2014)	Jant et al.	2.90–6.60 (4.94)	natural history museum	• parent elaborative talk: target objects • parent elaborative talk: nontarget objects • child spontaneous talk • joint talk	1: Pre-exhibit activity with conversation cards prompting *wh*-questions and associations. 2: Pre-exhibit activity exploring and investigating 6 objects. 3: Pre-exhibit activity with conversation cards and objects.

Museum signage as distributed mediation to encourage family learning	Dissertation (2009)	Kim	6–7	children's museum	• learning talk • total parent exhibit talk • total child exhibit talk • parent identification • parent description • parent simple inference • parent complex inference • parent connection • parents hands-on (exhibit interactive) • child identification • child description • child simple inference • child complex inference • child connection • child hands-on (exhibit interactive)	1: Exhibit signage with explanatory content and interaction suggestions (e.g., guiding questions). 2: Exhibit signage with explanatory content only.
STEM learning and transfer in a children's museum and beyond	Merrill-Palmer Quarterly (2017)	Marcus et al.	5–6 (5.87)	children's museum	• mother science process talk • mother technology talk • mother engineering talk • mother math talk • child science process • child technology talk • child engineering talk • child math talk	1: Researcher demonstration about sturdy buildings.
Encouraging spatial talk: using children's museums to bolster spatial reasoning	Mind, Brain and Education (2017)	Polinsky et al.	3.92–4.92 (4.40)	children's museum	• parent total words • parent spatial words • child total words • child spatial words	1: Parents provided conversation cards prompting shape-language. 2: Parents provided conversation cards prompting goal-oriented language.
Family learning in object-based museums: the role of joint attention	Visitor Studies (2015)	Povis & Crowley	5–8	natural history museum	• learning talk • objects noticed • joint attention	1: Explore dioramas in dark with flashlights to guide exploration. 2: Explore dioramas with prompts to guide object engagement.
Explain this, explore that: a study of parent–child interaction in a children's museum	Child Development (2019)	Willard et al.	4–6 (5.06)	children's museum	• parent machine talk • parent questions • parent imperatives • parent encouragement • child machine talk • child questions	1: Activity cards prompting parents in explanatory conversation. 2: Activity cards prompting parents to support child exploration.