

This is a preprint of a book chapter:

Allen, S., & Gutwill, J. P. (2016). Exploring Models of Research-Practice Partnership within a Single Institution: Two Kinds of Jointly Negotiated Research. In D. M. Sobel & J. L. Jipson (Eds.), *Cognitive Development in Museum Settings* (pp. 190-208). New York, NY: Routledge.

12

Exploring Models of Research–Practice Partnership Within a Single Institution

Two Kinds of Jointly Negotiated Research

Sue Allen and Joshua P. Gutwill

The Authors

Sue Allen is director of research at the Maine Mathematics and Science Alliance. Her current research focuses on strengthening the connections in out-of-school STEM education ecosystems, and on remote-coaching systems that provide professional development for afterschool providers in rural settings.

Josh Gutwill is director of visitor research and evaluation at the Exploratorium, a science museum in San Francisco. His work includes research on learning in informal environments as well as evaluation of exhibits and programs to improve visitors' experiences. In close collaboration with museum practitioners, he focuses on fostering and studying learners' self-directed inquiry in science museum settings.

Introduction

How can researchers increase the probability that the results of their studies actually affect practice? In the field of formal education, academic researchers are increasingly looking for ways to achieve this by collaborating with teachers and school administrators to co-develop questions, assessment methods, and interpretations of results. Such work can be extremely challenging (Coburn, Penuel, & Geil, 2013), because researchers and school-based practitioners have different goals and operate within disparate reward structures, driving them to prioritize different activities and value distinct sets of outcomes. The same issues are faced by university scholars studying learning in informal environments such as museums. To conduct meaningful research that improves practice, they need to gradually build new relationships with curators, exhibit developers, and educators (Callanan, 2012; Crowley & Knutson, 2005).

In this chapter, we describe the kinds of deep professional partnerships that can develop when both the researchers and practitioners belong to the *same* organization. We are Ph.D.-trained learning researchers who have spent years working closely with exhibit developers, educators, and curators at the Exploratorium, the museum of science, art and human perception in San Francisco. The first author founded an in-house Visitor Research and Evaluation (VRE) group in 1994 and left the museum in 2008; the second author currently directs the VRE group. Few museums in the world have an in-house evaluation group (and even fewer have a learning sciences research group). From our relatively unusual vantage point, we hope to highlight some key affordances and common challenges of deep intra-institutional research–practice collaborations that may be relevant to cross-institutional partnerships as well.

When the first author started at the Exploratorium, the museum's exhibit group was already an active and creative center with 25 years of international acclaim, a long history of successful grants from the National Science Foundation (NSF), and a staff of perhaps a dozen highly skilled exhibit developers. Frank Oppenheimer, the museum's founder, had established an enduring and powerful hands-on pedagogy, emphasizing deeply engaging phenomena, observable mechanisms, and artistic inspiration (Oppenheimer, 1968, 1972, 1974). Exhibits were considered "working prototypes," meaning they could always be improved (Oppenheimer, 1986). Toward that end, exhibit developers often informally observed visitors when iteratively changing or creating an exhibit, but such observations were usually not recorded or systematized.

Over the course of a few years, through embracing a practitioner-centered approach that intentionally focused on trust building, the VRE group developed strong relationships with several of the exhibit developers. Ultimately, our group became fully integrated into the exhibit development practices in the Exploratorium, with many developers even saying they could not build a successful exhibit without incorporating feedback through evaluation. In this chapter, we describe the culmination of this approach, which we call *jointly negotiated research* (JNR). We go on to describe two variations of this methodology, which have emerged for us as sufficiently different to warrant characterization as sub-types of JNR.

Much of our research has focused on exhibit design principles as they impact learning in museums. This is not accidental: We view public learning at museum exhibits as a surprisingly under-studied subdomain of the learning sciences, with great potential for increased involvement by learning researchers from many fields.

Why Conduct Learning Research in Museums?

For researchers who may be less familiar with museums as learning environments, we briefly list some of the benefits of conducting research on the public floor of a museum:

Museums are authentic learning contexts. Many of the learning-related phenomena of interest to the learning sciences community are readily observable in the museum setting, as they occur naturalistically over a range of social groups: collaboration and peer learning, conceptual change, embodied and situation cognition, motivation-engagement-identity, scientific reasoning and metacognition, and so on. In addition, many museums—especially science centers and children’s museums—utilize features of contemporary learning practices: intriguing phenomena, interactive participation, assumption of group learning, multiple modes of engagement, wide array of choices, hierarchies of salience, small modular text, and multi-sensory experiences (e.g., [Allen, 2004](#); (Borun et al., 1998); [Humphrey & Gutwill, 2005](#)). In this sense, exhibits support the kinds of modular, self-directed learning that is increasingly dominating 21st century learning opportunities, so they are excellent test-beds for motivational and conative as well as cognitive approaches to learning. Because visitors are entirely free to explore the space moment-by-moment, museums represent a quintessential anywhere-anyone-anytime learning environment, offering an array of interactive experiences to people of all ages and backgrounds.

Museums are designed to promote learning. By contrast with naturally occurring informal learning environments, such as forests and beaches, museums are *designed* to promote enjoyment and learning. Exhibits can be seen as physical embodiments of exhibit developers’ educational theories, and the inherent temporal separation of design (in the machine shop) and use (by visiting families) makes them quite similar to the carefully designed objects

developmental psychologists often use to tease out children's understandings of the world. But exhibits are also worthy of study as complex motivational objects: To be successful in facilitating learning, they need to support visitors' agency while guiding discovery in particularly fruitful directions, subtly provoking conversations that advance learning in particular content areas. As Michael Spock says, "Exhibit design *is* rocket science" (McLean & McEver, 2004, p. 2).

Museum exhibits afford experimental manipulation. Exhibits make especially powerful micro-settings for studying learning because they are typically used in "stand-alone" mode, without a human teacher to mediate. This makes them adaptable for detailed comparative experiments of the kind commonly designed by developmental psychologists in a setting with very large numbers of participants using them in short time scales. In addition, the in-house teams of designers, builders, editors, and graphics experts make it possible to test a broad set of design variations. There are, of course, significant nuisance variables at play in museums, but these can be ameliorated to some degree with careful design (Allen et al., 2007). The combination of these experimental affordances, along with the previous two attributes (authentic and intentional environments for learning) make museum exhibit spaces rich "contexts for studying developmental change" as well as "settings for conceptualizing, designing, and evaluating interventions" (Callanan, 2012, p. 140).

Researchers are developing context-appropriate assessments. Over the past few decades, researchers in museums have developed observational methods for assessing learning in ways that avoid making participants feel tested (e.g., Allen, 2002; Barriault & Pearson, 2010; (Borun, et al., 1998); Callanan, 2012; Crowley & Callanan, 1998; Gutwill, 2003, 2005; Serrell, 1998; Van Schijndel, Franse, & Rajmakers, 2010). More recently, advances in mobile phone

technology, indoor positioning, embedded cameras and microphones, and software for automated audio, facial, and gestural analysis show near-term promise for conducting high-speed, anonymous tracking of large numbers of visitors as they move, interact, and speak together (ByteLight, 2013; Ma, 2014; Rowe, 2015).

Jointly Negotiated Research

Having described some of the advantages of studying learning in museums, we return to the question of how to conduct such studies in ways that maximize their impact on practice. We use the term “jointly negotiated research” to refer to research that engages both researchers and practitioners in deep and meaningful partnerships where decision-making power is shared. To characterize such research, we start with the definition that the second author and his colleagues at the Exploratorium have been developing (Bevan, Gutwill, Petrich, & Wilkinson, 2014, p. 4), based upon work in formal education (Coburn et al., 2013). In this view, JNR incorporates the following principles:

- 1) *Negotiate problems of practice* that are of equal interest and importance to both researchers and practitioners.
- 2) *Advance both theory and practice.*
- 3) *Engage in collaborative design work* to explore and test new practices.
- 4) *Build capacity to sustain change* beyond the immediate term of the research project.

By definition, JNR gives equal priority to the goals, perspectives and professional needs of researchers and practitioners. In our experience, such equality takes time to develop fully, but builds institutional capacity through trust, mutual understanding and common purpose.

One of the key features of JNR is that it does not need to be translated into practice, because it is already grounded in practice. We would argue that the prevalent notion of late-stage, one-way “translation” from research to practice harkens back to transmission metaphors of learning that pre-date constructivist and socio-cultural perspectives, and that such metaphors are quite limiting to the formation of true partnerships. We see practitioners as creative professionals who have highly valuable expertise based on their knowledge and experience of creating engaging educational experiences for public audiences. Because of this, they can contribute significantly to the usefulness and applicability of the research by helping researchers to ask better, more relevant questions.

Two Forms of Jointly Negotiated Research

We further subdivide JNR *based on the degree to which researchers and practitioners retain their separate roles as they collaborate*. Our experience has shown that these two subtypes of JNR tend to differ in terms of characteristics (3) and (4) of JNR: the nature of power-sharing in the collaboration, and the potential for organizational capacity-building.

a) JNR-D

In jointly negotiated research with differentiated roles (JNR-D), researchers and practitioners share design-making power as they design and implement research studies, but retain their

traditional roles throughout the process, “passing the baton” of decision-making back and forth as the research evolves. The researcher’s role is to observe practitioners’ practices long enough to identify candidates of theoretical interest and potential for generalizability (making them research rather than evaluation), and to work with the practitioners to choose a particular design decision that will be of immediate use to them before the end of the project. Timing is critical here: too early and the study may be irrelevant to the actual design challenges, but too late and it may inform the field but not the immediate project. Typically, in our context, these studies are principled comparisons between plausible design alternatives. They are often difficult to write into project proposals ahead of time, because it may be difficult to anticipate which design dilemmas will dominate a particular development process; in this sense, JNR-D is usually opportunistic in nature. Because of the alternating phases of decision-making, this type of research builds institutional capacity by surfacing different perspectives and allowing researchers and practitioners to better understand each other’s language and practices.

b) JNR-I

In jointly negotiated research with integrated roles (JNR-I), research and practice are built simultaneously by a single collaborative community of researchers and practitioners working toward a common goal. The researchers and practitioners collaborate deeply from the earliest stages of a project to the very end, and jointly characterize both the desired learning impacts and the means of achieving them. JNR-I requires periodic deep negotiation of goals, key constructs, assessments, and inferences. Typically this happens when a project attempts a bold and innovative objective (e.g., having learners drive their experiences for themselves instead of following the museum’s instructions). The discussions can be challenging, as teams wrangle

between the research goals of coherent constructs and the practice goals of optimal design. If the project succeeds, a compromise is reached where practitioners are truly guided by the research data, but retain a large enough design space to create effective learning offerings on an individual level. By the end of such a process, there is full ownership of all, intimate familiarity with the final designs and their learning impacts, and a side effect of powerful bonding within the team. We characterize this as the highest level of institutional capacity-building.

What Do JNR-D and JNR-I Look Like?

To illustrate the two types of jointly negotiated research, we offer brief vignettes from our own experience working in these two genres with Exploratorium practitioners.

Vignette 1: JNR-D

As an example of JNR-D, we describe a small, focused study on alternative designs for exhibits featuring living microscopic organisms. Practitioners and researchers contributed equally to the shaping of the study, but in different ways that reflect their professional training: Practitioners primarily contributed their exhibit-development experience, while the researcher primarily contributed her experimental design expertise.

Roughly one year into an NSF-funded Exploratorium project to develop biology exhibits with living organisms (*Traits of Life*), the researcher, who also acted as the evaluator conducting formative evaluation on early exhibit prototypes, made a list of approximately ten design dilemmas that seemed to be arising repeatedly in evaluation studies. They seemed generalizable enough to warrant systematic study, yet specific enough to the domain of *Traits of Life* to justify

conducting them with project resources. The researcher shared the list of design dilemmas with the development team, and the practitioners ranked them in terms of what they found the most useful and relevant to their current work on the project.

In this case, the team selected the design issue of *how much user interactivity to build into exhibits with microscopes used to examine live organisms*. This constituted a genuine dilemma of practice, not a trivial detail, because the practitioners were grappling with an inherent trade-off in terms of the learning outcomes that different degrees of interactivity afford:

Including more interactive features allows visitors to explore more variations of the exhibit but actually makes it more difficult for them to rapidly locate a well-focused, well-positioned sample. The team's research question became: "What is the optimal level of physical interaction we should give visitors using live specimens under a microscope? Do more interactive features contribute to visitors' learning, or not?"

The researcher then developed a randomized block design study to answer this research question (see Table 12.1). She created a 3x2 matrix of exhibit versions, to allow for testing three levels of interactivity (multiple interactive features; one interactive feature, or none), and two variations in the presentation of worms (live or previously recorded).

At this point, the practitioners were again key to the research design: they identified which of these six exhibit variations were worthy of study and which would be unrealistic. For example, exhibit developers would not go to the bother of putting interactive features on a video-recorded phenomenon, which was seen as wasteful and disingenuous; nor would developers put all the expense into a living sample without giving the visitor at least some interactive features. These cultural norms allowed us to simplify the study to only three exhibit variations:

Table 12.1: Final study design of JNR study on levels of interactivity in microscope exhibits.

	Interactivity: Multiple Features	Single Feature	None
Live Specimens	X	X	
Video			X

Ultimately, the study findings showed that visitors were more engaged by, and learned more from, the exhibit version that had live worms and interactivity, but that a single interactive feature was as effective as multiple features.

This vignette illustrates several aspects of JNR-D, with the researchers and practitioners maintaining their respective roles. The researcher’s role was to frame the questions, design the experiment and analyze the results, while practitioners offered important constraints, made key choices throughout that process, and built ingenious physical devices to enable quick rotation among the different exhibit versions to reduce the confounding influence of nuisance variables during the study.

Vignette 2: JNR-I

An example of JNR-I was the NSF-funded project called *Going APE*. In this project, the primary goal itself—active prolonged engagement (APE)—was a construct jointly negotiated between the practitioners and the researchers. When the project began, all team members agreed that “prolonged” referred to visitors spending more than typical time at exhibits. But the term “active” was much harder to operationalize, and ultimately formed the driving issue behind the entire project for both researchers and practitioners.

In the first year of the project, the researchers pushed to define APE as prolonged *scientific inquiry*, where visitors would ask questions, conduct systematic experiments, and make observations and interpretations. The practitioners, in contrast, felt that such investigative inquiry was far too narrow a definition. They proposed including free-form *exploration*, in which implicit questions (e.g., “What happens if I push this?”) would lead to trying different things.

After months of argument, consensus finally came when the group adopted the practice of joint video analysis. Ground rules were set such that any team member could nominate an existing exhibit for the researchers to videotape. Then, when viewing the videos together, team members would “call out” moments of interest, trying to identify the kinds of interactions that would illustrate their view of APE. Rather than simply trade opinions, the group sought evidence for their claims and examples to demonstrate their ideas.

Over the next few months, exhibit developers and researchers brought videos home, watched them and then showed their curated call-outs to the rest of the team. By viewing and discussing together, and by both groups keeping an open mind about the meaning of APE, a jointly agreed-upon definition emerged: Active engagement meant that exhibits would allow visitors to “drive the experience” for themselves. Intentionality was key—in the new definition, visitors were “active” when they decided for themselves what to do next, rather than following instructions from the museum. The goal of the project became building exhibits that were open-ended enough to foster a self-authored experience that could involve exploration *and* investigation, as well as other interactions like construction and observation. This represented a profound shift in outcome goals for exhibits that resonated with museum practitioners and researchers in the greater museum field (e.g., [Hein, 2012](#); [Horn et al., 2012](#)).

The jointly negotiated definition of APE was only the beginning of the deep collaboration; every exhibit the developers created was videotaped and analyzed by the researchers for (prolonged) time at the exhibit and self-driving behaviors. Roles blurred as the practitioners watched the videos for themselves, saying they “couldn’t tell if it was an APE exhibit” until they had seen and heard multiple visitor groups use it. The researchers also switched roles, building an exhibit prototype to test one of their own ideas. Together, the team implemented three quasi-experimental studies, using video, interviews, and real-time observations to make comparisons among conditions.

The APE project exemplifies JNR-I in that the very goal of the project was jointly negotiated and required both development and study to achieve. Roles were malleable, with developers learning to demand evidence and researchers learning about the intricacies of design. The project advanced both theory and practice in the realm of designing learning experiences in museums. Although the process was time-consuming, with much disagreement and emotion, the deep commitment to consensus-based decision-making resulted in acclaimed contributions to theory and practice, and a remarkable degree of joint ownership.

Comparisons With Other Types of Museum Research

In Table 12.2, we give a simplified summary of the key characteristics of the two kinds of JNR we have described above.

For comparison, we also include *Independent Research* that is conducted in a museum setting, but is not significantly connected to the work of the practitioners. For example, a psychologist might use a space in the museum because it is a convenient place to recruit and

study participants for a study of risk sensitivity, and debrief them afterwards (e.g., [Kunreuther, Novemsky, & Kahneman, 2001](#)). Such research is typically, but not necessarily, conducted by university-based researchers, and was already well-established (by Sally Duensing and others) before we arrived at the Exploratorium. It is growing in popularity and quality, thanks in large part to the Living Lab project at the Museum of Science, Boston ([Boston Museum of Science, 2010](#); Corriveau et al., this volume). In the Living Lab model, practitioners create a space within the museum for researchers to use to recruit and study participants (often children), either singly or in dyads or groups doing specified activities.

Drawing from Bevan ([Bevan et al., 2014](#)), we include in the table *Collaborative Research*, which we elaborate in several key dimensions. We see this as research conducted with help and advice from practitioners or using the educational offerings that practitioners have created. However, the researcher's role is primary, driving the process with a well-defined initial theoretical question and making all major decisions regarding study design, implementation, analysis, write-up, and dissemination. An example is Allen's ([Allen, 1997](#)) study of an exhibit called *Colored Shadows*, which was used for a study of inquiry skills: The existing exhibit (created by skilled exhibit developers) provided an intriguing phenomenon, and the researcher created labels that embodied different inquiry tasks to be used in a mediated way with visitors in a randomized block-design study.

The dimensions in the table begin with those related to the four principles we used (previously) to characterize JNR. Specifically:

- 1) JNR is initially inspired by a *problem of practice*, rather than a theoretical question, as would be typical of other kinds of research. Also, the museum setting is seen not just as a

source of subjects (as in Independent Research) or as a convenient source of exhibits and programs to be used as props (as in Collaborative Research), but as a collections of educational interventions that can be assessed, studied and changed (c.f. Callanan, 2012).

- 2) JNR goes beyond the goal of having “implications” for practice and instead *advances practice as it advances research*. Typically this happens through a process we call “reciprocal innovation,” where creative explorations in research and practice drive each other in ways that build both.
- 3) In JNR, the design and research work is *extremely collaborative*, so that neither the researcher nor the practitioner can fully anticipate what will be learned. Even research questions emerge through joint negotiation. Responsibility for the research is shared, either through a process of alternating responsibility (in JNR-D) or a blurring of roles (in JNR-I).
- 4) JNR *builds capacity to sustain change* in the museum as well as the research team. Changes in practice happen throughout the project, because the innovations driven by research questions are aligned to established practices and involve practitioners in the design process. Because of the merging of roles in JNR-I, this represents the type of research with the greatest potential to impact practice in a sustained way, while it also builds capacity in the sense of maximizing professional development of researchers and practitioners in relation to each other’s work.

Aside from these four principles, we include in the table some implementation issues: key challenges, optimal timing within a project, and overall efficiency of each type of research.

Table 12.2: Properties of jointly negotiated research in relation to other types of museum

research.

Dimension		Independent Research	Collaborative Research	JNR-D	JNR-I
1) Research Focus	Source of inspiration	Learning theories	Learning theories	Problems of practice	Problems of practice
	Perspective on the museum as learning environment	Source of subjects for experimental studies	Source of objects and practices to be incorporated as props into relevant research	Source of malleable educational interventions	Source of malleable educational interventions
2) Field Advancement	Knowledge-building contributions	Builds theory, no significant impact on practice	Builds theory, implications for practice	Builds theory and advances practice (“reciprocal innovation”)	Builds theory and advances practice (“reciprocal innovation”)

3) Collaboration and Power	Research questions	Predetermined by researcher	Determined by researcher with input from practice or embedded in current objects/practices	Emergent through joint negotiation	Emergent through joint negotiation
	Principal decision-maker	Researcher	Mostly researcher	Alternating	Fully shared
	Researcher's role	Conducts all aspects of research	Conducts research that incorporates authentic elements of the museum	Identifies potentially generalizable practice-based issues, designs study with input from practitioners, analyzes and disseminates findings	Conducts inclusive research and participates in practice

	Practitioner's role	Gives researcher consent to use the space, recruit, collect data	Provides access to suitable objects and practices, with minor tweaks as needed	Opens practice to scrutiny, identifies realistic interventions, creates variations for study	Includes researcher in practice, participates in research
4) Capacity-Building	Capacity to sustain change over time	Negligible	Low	Medium	High
5) Implementation Issues	Key challenge	Recruiting, sampling, collecting data outside a controlled laboratory environment	Identifying objects and practices that allow research questions to be addressed	Finding theoretical construct of genuine interest to practitioners	Achieving convergence in time to impact research and practice

	Timing within an R&D project	n/a (independent of development)	n/a (independent of development)	Phased: early and late in a project, majority of research activity follows majority of development	Throughout a project, constantly iterative, research and developmen t drive each other
	Efficiency	High	Medium	Low	Very low
Example Study		Risk Sensitivity	Colored Shadows	Microscope Interactivity	Active Prolonged Engagement

Getting to JNR

[Callanan \(2012\)](#) and [Crowley and Knutson \(2005\)](#) point out that early evaluation of exhibits served as key early stages in their research–practitioner partnerships. For us as in-house researchers, the same has been true. Through formative evaluation of individual exhibit prototypes, our VRE group was able to move from independent and collaborative research (with relatively low impact on practice) to JNR studies, which are now our most common form of research.

In some cases the evaluation identified general issues that could be studied more rigorously across multiple exhibits. For example, early evaluation of one of the *Going APE* exhibits, *Spinning Blackboard*, led to an exhibit developer thinking creatively about ways to design for independent yet sharable strategies by visitors using an exhibit; this in turn led to a whole series of studies of “multi-station exhibits” and inclusion of this concept in the theoretical framing of APE behavior. In other cases, we formatively evaluated exhibit use and visitor interactions by recording videos of learners, which were later analyzed more carefully to answer a research question.

A key point is that it took the exhibit research and practice team several years to fully establish the two forms of JNR described above. They were not immediately embraced by practitioners, even when more traditional formative evaluation practices had permeated all team projects. Practitioners raised (and still raise) legitimate concerns about the extended times involved and the significant budgetary resources required to do research as rigorous as that which the researchers wanted to conduct. Not every question deserves the kinds of deep dives that characterize JNR, and our in-house staff still conducts the full range of research types listed in Table 12.2, as well as a great deal of formative evaluation. Luckily, we have found that these studies inform and cross-pollinate frequently. For example, a decade-long focus on deepening inquiry at exhibits interwove the threads of extensive evaluation work, JNR-I studies in *Going APE*, (Humphrey & Gutwill, 2005) and JNR-D studies on programming interventions in *Juicy Question* (Gutwill & Allen, 2010).

Reflections on Haden, Cohen, Uttal, and Marcus

Our examples have been from our research work as museum-embedded researchers. We now turn to consider **Chapter 5** as an example of JNR, in this case conducted across institutions by in-house practitioners and university researchers. Based on our previous framework, we would classify this work as JNR because it meets all four of the defining principles:

- 1) *Negotiate problems of practice* that are of equal interest and importance to both researchers and practitioners.

The authors very intentionally identified an issue of importance in museum practice (viz., how to enhance learning through narrative reflection), and framed it with an appropriate theoretical lens (parent–child conversations and memory development). In doing so, they also addressed two more general recurring issues of great interest to museum practitioners: how to extend the museum experience over time and across settings, and how to infuse science content (in their example, the role of triangles as effective structural supports) into interactive experiences without making it didactic. In other words, they successfully identified a very fruitful area of focus of central interest to research and practice.

- 2) *Advance both theory and practice.*

The authors' choice of focus—narrative reflection—was not only of joint interest to research and practice, but was of a sufficiently large grain-size to warrant

multiple studies and the development of innovative extensions to existing practices.

The work advanced *research* by showing specific ways that “narrative reflection can be an integral part of the learning process, providing possibilities for extended encoding . . . beyond the duration of the activity itself” (p. ?). This connects strongly with the concept of “preparation for future learning” of [Bransford and Schwartz \(1999, p. 68\)](#) and addresses the essential theoretical question of how learning experiences build over time.

Methodologically, the use of time-lapse cameras and prompts for narrative construction provides a wonderful example of ecologically valid embedded learning assessments in informal settings, something researchers continue to call for (e.g., [NRC, 2009](#)). In addition, it showcases how relatively minor adjustments (such as small changes to an exhibit or a simple framing suggestion to visiting families) can allow the researching team to explore many variations and find intriguing results relatively quickly.

In terms of *practice*, this research addresses the well-known museum challenge of extending the learning experience from a typically engaging, hands-on interaction to something with a more reflective component that might be remembered over time and applied in other settings. The study series also generated a useful set of principled, explicit probes, helping caregivers facilitate their children’s learning by connecting it to future experiences.

Finally, the studies' results—that amount of STEM talk was increased only by combining engineering principles with prompts to ask questions—were immediately implementable into museum programs.

3) *Engage in collaborative design work* to explore and test new practices.

A particular strength of Haden et. al.'s work is the way their research questions and development practices interweave and inform each other, as is typical of JNR. For example, the team's wish to understand the effects on memory of the commonly observed phenomenon of "reunion narratives" led to the development of an experimental orientation experience that was later incorporated into the museum's regular exhibit and related programming.

Importantly, this kind of tight interweaving was maximized through the team's deliberate choice of research interventions that are variations of existing practices in museums. Haden et al. give several other examples:

- "Narrative reflection" is based on a well-documented behavior that families already engage in following museum-based experiences: telling others about their visit when they get home.
- "Inspector Sturdy" imitates the role-playing programs that are common in museums.
- Even the suggested question prompts and connections to prior experience are what skillful families tend to do as they learn together in museums (e.g.,

Allen, 2002; Borun, Chambers, & Cleghorn, 1996; Gutwill & Allen, 2010),

so it is not surprising that families who get to practice it, do it later spontaneously.

As the authors suggest, all of these are ways to scaffold facilitation for caregivers who may not know how to support their children's learning, and all are based on the spontaneous practices of skilled caregivers in the same setting. We agree that the fruits of this entire partnership would have been much weaker without the intentional connections to established practices of staff, parents, and children.

4) *Build capacity to sustain change* beyond the immediate term of the research project.

Haden et al. describe research that extends beyond a single study or even series of studies to relationships that continue to grow and cross-pollinate over time. The research team now includes multiple research faculty and a number of research assistants and students, such growth that the museum has felt compelled to create “a system for thinking about and responding to different kinds of requests” (p. ?). Perhaps most tellingly, the authors report that research has become “part of the culture” (p. ?) at the museum, bringing new tools and perspectives that have been readily embraced.

JNR-D or JNR-I?

It is difficult to tell whether Haden et al.'s research was JNR-D or JNR-I, because the authors focus on the whole team's process, rather than the roles played by different members.

Nevertheless, we might speculate that the work leans toward JNR-I because the authors promote "practitioners and researchers who are willing to . . . *determine together* interventions and methodology that can advance research and practice" (p. ?).

Either way, we see their work as a beautiful model of JNR across institutions.

A Causal Account of JNR

In **Chapter 1**, the editors of this volume note that it contains a variety of frameworks, names, and criteria for different levels and types of collaboration. They also note several likely causal mechanisms. Below we propose our own interpretation of the causal relationship among three levels of partnership principles, incorporating those suggested by Haden et al. where possible, and drawing on our own experience as well as the experiences of others described later in this chapter (e.g., Maureen Callanan, Kevin Crowley, and Karen Knutson). In brief, we propose that a single driver is supported to a greater or lesser extent by nurturing factors, leading ultimately to emergent properties that characterize JNR.

Drivers. We resonate with Haden and colleagues' recognition of the key significance of having "one dedicated, even passionate person on each end of the partnership who can make the time to find common ground" (p. ?). In fact, we see such a partnership as the only essential driver of JNR. We would argue that partners need to be *curious, flexible, and committed to*

advancing practice (JNR principle 3 on collaborative design). Flexibility is essential because no matter how aligned their interests seem to be, there will always be a need to learn from each other and adapt to the stream of incoming findings as the research unfolds.

Nurturing Factors. There are several nurturing factors that significantly support the partners as they build their JNR partnership. Three of the most salient are proximity, time, and institutional support. (1) By *proximity*, we mean easy communication that allows for frequent exchanges of ideas. Ideally, partners are physically near each other, but frequently used videoconferencing tools may allow for something similar with a remote presence. (2) Prolonged *time* for the partnership, preferably in decades but at least in years, builds empathy, common language, and joint goals. Usually this also means that stable funding is required. (3) JNR is also nurtured through *institutional support*, particularly from the museum side, that values and welcomes the deep involvement of a researcher. (4) Finally, JNR thrives within a *practice-based subdomain of the right grain-size* to afford multiple directions of exploration for both research and practice (JNR principle 1 on finding problems of practice; similar to Haden's "degree of alignment," p. ?). We think of this as a nurturing factor rather than an essential driver because we believe two curious and open-minded partners with enough time and support will almost invariably find an area of overlapping interest in the study of practice; at the same time, if there is already an articulated subdomain of mutual interest (such as narrative reflection) then this may accelerate, extend, or simplify the relationship-building process.

Emergent properties. When enthusiastic research–practice partners have the time, proximity, and support they need to unearth and pursue jointly negotiated questions, several properties of JNR emerge naturally: (1) Both partners *relinquish some individual control* and adjust what they are fundamentally willing to explore, based on the perspective of the other

partner. (2) As partners gradually learn to think more like each other, there may be *increased role-blurring*. (This is the issue that distinguishes JNR-D from JNR-I and relates to JNR principle 3 on collaborative design.) (3) The *researchers gain greater permission* from practitioners to intervene. (We see this in Haden’s correlation of research method with seniority of research personnel.) (4) Both *research and practice advance* via “reciprocal innovation.” This means that the partnership spins off a series of innovations in practice that are interwoven with discoveries in research, neither of which could be fully anticipated at the outset (JNR principle 2 on advancing both theory and practice). (5) Finally, *long-term capacity increases for both sides*, as more researchers become interested in the domain, and as practitioners incorporate the innovative practices into their regular repertoires (JNR principle 4 on capacity-building).

Of course, the emergent properties further reinforce the drivers and nurturers, so the linear causality is ultimately cyclical.

Other Cross-Institutional Examples

That Haden et. al. were able to conduct cross-institutional JNR is a major feat; this kind of deep partnering is not easy even within an organization.

It has also been achieved by Maureen Callanan, a developmental psychologist at UC Santa Cruz, who has worked for many years in an equal partnership with the practitioners at the San Jose Children’s Museum (Callanan et al., this volume; [Crowley & Knutson, 2005](#)). During her research studies, Callanan also conducts formative evaluation for the museum, serving practitioners’ needs in parallel with her own. She uses an evaluation approach called “blitz coding,” originally developed by her then-post-doc Kevin Crowley. In this approach, the

researcher helps practitioners by employing students to quickly code videos of visitors so as to give exhibit developers timely feedback (Crowley & Knutson, 2005; Knutson & Crowley, 2005). The videos then also serve the needs of the research later in the project.

In his own right, Kevin Crowley has conducted JNR by setting up a partnership between his academic institution—the University of Pittsburgh—and the Children’s Museum of Pittsburgh, studying learning within the museum. Crowley and his colleague Karen Knutson report that they first conducted research independent of practice, then gradually started helping the practitioners by offering small evaluations of exhibits, and finally began conducting jointly negotiated research (Crowley & Knutson, 2005; Knutson & Crowley, 2005). Interestingly, after a few years of working in partnership with practitioners from the Children’s Museum, Kevin founded the museum’s Department of Visitor Research and Evaluation and became its first director, all the while working as a professor at the university. By becoming in-house researchers while maintaining academic appointments, Crowley, Knutson and their colleagues created a hybrid of Callanan’s model and ours.

A Potential Model for Cross-Institutional JNR-I

The Exploratorium is currently exploring a cross-institutional model for research–practice partnerships that might allow academic researchers to engage in the most deeply collaborative of our models, JNR-I, without being on staff. The project, *Exhibits for Social Science Research*, involves university-based social science researchers working closely with exhibit developers to create engaging exhibit experiences for visitors. Simultaneously, the exhibits will be structured so as to collect useable data for the outside researchers. The project has already garnered interest

from behavioral economists, social psychologists, and developmental psychologists. In essence, we wish to create a social science laboratory on the museum floor, populated with interesting, educational exhibit experiences that simultaneously gather data for research. Our hope is that this laboratory will give academic researchers the opportunity to truly co-design exhibits at the same time as it offers exhibit developers the chance to contribute significantly to methodological design, blurring the disciplinary boundaries in the service of exhibits that achieve multiple purposes simultaneously.

Closing Thoughts

As a process, JNR has some particular challenges. For example, it is often difficult to identify fruitful research questions within a complex design process (e.g., those that are interesting, generative, tractable, at an appropriate level of abstraction). In this sense, the process is similar to the practice of asking fruitful questions in scientific inquiry (either in a classroom or at an exhibit), but with the additional constraint that the question should be considered worthy of study and not already answered by both practice and research communities.

At the same time, we would argue that JNR is worth the additional challenges because the potential impacts on practice and institutional capacity-building are much greater than with the other types. JNR generates long-term, simultaneous professional development for both researchers and practitioners in an authentic context of advancing actual current practice. Researchers come to appreciate the norms, complexities, and constraints of a design environment, while practitioners come to appreciate the norms, complexities, and constraints of conducting systematic inquiry through a theoretical lens. In a successful JNR project, both

researchers and practitioners gain credibility through their joint ownership of the work, and they tend to disseminate more often and across a much broader set of professional communities.

References

- Allen, S. (1997). Using scientific inquiry activities in exhibit explanations. [Special issue]. *Science Education*, 81(6), 715–734.
- Allen, S. (2002). Looking for learning in visitor talk: A methodological exploration. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 259–303). Mahwah, NJ: Lawrence Erlbaum Associates.
- Allen, S. (2004). Designs for learning: Studying science museums exhibits that do more than entertain. *Science Education*, 88(Supplement 1), S17–S33.
- Allen, S., Gutwill, J. P., Perry, D., Garabay, C., Ellenbogen, K., Heimlich, J., . . . Klein, C. (2007). Research in museums: Coping with complexity. In J. Falk, L. Dierking & S. Foutz (Eds.), *In principle, in practice: Museums as learning institutions* (pp. 229–246). New York: Rowman & Littlefield Publishers.
- Barriault, C., & Pearson, D. (2010). Assessing exhibits for learning in science centers: A practical tool. *Visitor Studies*, 13(1), 90–106.
- Bevan, B., Gutwill, J. P., Petrich, M., & Wilkinson, K. (2015). Learning through STEM-rich tinkering: Findings from a jointly negotiated research project taken up in practice. *Science Education*. 99(1), 98-120.

- Borun, M., Chambers, M., & Cleghorn, A. (1996). Families are learning in science museums. *Curator: The Museum Journal*, *39*(2), 123–138. doi: 10.1111/j.2151–6952.1996.tb01084.x
- Borun, M., Dritsas, J., Johnson, J. I., Peter, N. E., Wagner, K. F., Fadigan, K., . . . Wenger, A. (1998). Family learning in museums—The PISEC perspective.
- Boston Museum of Science. (2010). Living laboratory materials.
- Bransford, J., & Schwartz, D. (1999). Chapter 3: Rethinking transfer: A simple proposal with multiple implications. *Review of Research in Education*, *24*, 61–100.
- ByteLight. (2013). ByteLight illuminates the Museum of Science. <http://blog.bytelight.com/post/40011523606/bytelight-illuminates-the-museum-of-science—.VUL-6mZXUqg>
- Callanan, M. A. (2012). Conducting cognitive developmental research in museums: Theoretical issues and practical considerations. *Journal of Cognition and Development*, *13*(2), 137–151.
- Coburn, C. E., Penuel, W. R., & Geil, K. E. (2013). Research-practice partnerships: A strategy for leveraging research for educational improvement in school districts (p. 24). New York: William T. Grant Foundation.
- Crowley, K., & Callanan, M. (1998). Describing and supporting collaborative scientific thinking in parent-child interactions. *Journal of Museum Education*, *23*(1), 12–17.
- Crowley, K., & Knutson, K. (2005). Museum as learning laboratory: Bringing research and practice together (part 2 of 2). *Hand to Hand: Association of Children's Museums*, *19*, 3, 6.

Gutwill, J. P. (2003). Gaining visitor consent for research II: Improving the posted-sign method.

Curator, 46(2), 228–235.

Gutwill, J. P. (2005). Observing APE. In T. Humphrey & J. Gutwill (Eds.), *Fostering active*

prolonged engagement: The art of creating APE exhibits. Walnut Creek, CA: Left Coast Press.

Gutwill, J. P., & Allen, S. (2010). Facilitating family group inquiry at science museum exhibits.

Science Education, 94(4), 710–742.

Hein, G. (2012). *Progressive museum practice: John Dewey and democracy*. Walnut Creek, CA:

Left Coast Press.

Horn, M., Leong, Z. A., Block, F., Diamond, J., Evans, E. M., Phillips, B., & Shen, C. (2012). Of BATs and APEs: an interactive tabletop game for natural history museums. Paper presented at the ACM Annual Conference on Human Factors in Computing Systems, pp. 2059-2068, New York, NY: ACM.

Humphrey, T., & Gutwill, J. P. (Eds.). (2005). *Fostering active prolonged engagement: The art*

of creating APE exhibits. Walnut Creek, CA: Left Coast Press.

Knutson, K., & Crowley, K. (2005). Museum as learning laboratory: Developing and using a

practical theory of informal learning (part 1 of 2). *Hand to Hand: Association of Children's Museums*, 18, 4–5.

Kunreuther, H., Novemsky, N., & Kahneman, D. (2001). Making low probabilities useful.

Journal of Risk and Uncertainty, 23(3), 103–120.

Ma, J. (2014). *Using an indoor positioning system to automate visitor tracking*. Paper presented

at the Visitor Studies Association, Albuquerque, NM.

McLean, K., & McEver, C. (Eds.). (2004). *Are we there yet? Conversations about best practices*

in science exhibition development. San Francisco, CA: The Exploratorium.

National Research Council [NRC]. (2009). *Learning science in informal environments: People, places, and pursuits*. Washington, DC: National Academies Press.

Oppenheimer, F. (1968). A rationale for a science museum. *Curator*, 11(3), 206–209.

Oppenheimer, F. (1972). The Exploratorium: A playful museum combines perception and art in science education. *American Journal of Physics*, 40(7), 978–984.

Oppenheimer, F. (1974). The study of perception as a part of teaching physics. *American Journal of Physics*, 42(July), 531–537.

Oppenheimer, F. (1986). Working prototypes: Exhibit design at the Exploratorium. San Francisco, CA: The Exploratorium.

Rowe, S. (2015). Free-choice learning lab. <http://oregonstate.edu/freechoicelab/>

Serrell, B. (1998). Paying attention: Visitors and museum exhibitions. Washington, D.C.: American Association of Museums.

Van Schijndel, T. J. P., Franse, R. K., & Raijmakers, M. E. J. (2010). The exploratory behavior scale: Assessing young visitors' hands-on behavior in science museums. *Science Education*, 94(5), 794–809. doi: 10.1002/sce.20394