Technology-Enhanced Learning Communities on a Continuum between Ambient to Designed: What Can We Learn by Synthesizing Multiple Research Perspectives?

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Abstract: This symposium brings together the theoretical and practical tools of scientists in both the social and educational sciences in order to examine the types of interaction, knowledge construction, social organization and power structures that: (a) occur spontaneously in technology-enhanced learning communities or (b) can be created by design. We refer to these, respectively, as the study of *ambient*, naturally occurring, environments, and of *designed* environments. We present a set of seven studies that demonstrate the strong potential for the cross-fostering of ideas between educational scientists, who focus on the interventionist design-based study of learning, and social scientists, who focus on the analytic study of ambient social interaction and knowledge construction. Each study demonstrates specific insights regarding lessons that can be learned from the ambient to the designed arena, and vice versa, using lenses that integrate our various disciplinary research perspectives.

Keywords: Technology-enhanced learning, Learning communities, Networked society, Design

The overall focus of this symposium

One of the most significant developments in contemporary education is the shift of research and practice away from the focus on the individual learner to the view that knowing and understanding are anchored in cultural practices within communities. This shift coincides with technological advancements, such as the introduction of the World Wide Web and subsequently Web 2.0 technologies, which reoriented end-user computer interaction from individual work to communication, participation and collaboration. However, while daily interactions are increasingly engulfed in mobile and networked Information and Communication Technologies (ICT), in-school learning interactions are, in comparison, technologically impoverished, creating the phenomenon known as the school-society digital disconnect (Selwyn, 2006).

We can no longer consider "schooling" and "society" as separate entities. Rather, we must bring together the theoretical and practical tools of scientists in both the social and educational sciences in order to examine what types of interaction, knowledge construction, social organization and power structures: (a) occur spontaneously in technology-enhanced learning (TEL) communities or (b) can be created by design of TEL. We refer to these, respectively, as the study of *ambient*, naturally occurring, environments, and of *designed* environments. By adopting a definition of learning as the co-creation of knowledge in TEL communities, and by bringing together a cohort of expertise within the fields of education and the social sciences (i.e., education, learning sciences, communication, health and social welfare, knowledge management, information sciences, law, and instructional design), the Learning in a NetworKed Society (LINKS) Center seeks to study the continuum between the ambient and the designed arenas (LINKS, 2013).

In this symposium, we present a set of seven studies that are conducted as part the LINKS Center, which explore learning in various settings on the continuum between ambient and designed technology-enhanced environments (Figure 1). Each study demonstrates a particular aspect of learning and highlights a specific insight regarding what can be learned from the ambient to the designed arenas, and vice versa, using lenses that integrate various disciplinary research perspectives.

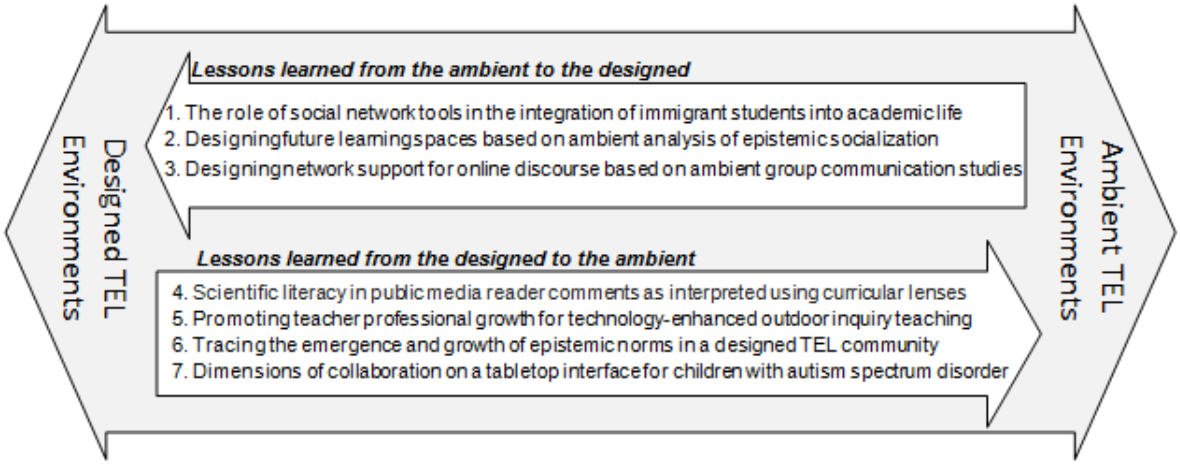

Figure 1. The studies of this symposium on an ambient-designed TEL communities continuum

The symposium will be carried out as a structured poster session, starting with a rationale and background presented by the organizers (10 minutes), then brief introductions from each of the poster presenters (15 minutes), followed by concurrent poster interactions (30 minutes), remarks from the discussant, Christopher Hoadley (15 minutes), and finally, a discussion with the audience facilitated and summarized by the chair, Paul Kirschner (20 minutes).

Theoretical background

The turn to community and communication in education and technology

Several sociocultural theoretical frameworks have been developed to describe learning as active participation in a community. Communities of practice (Wenger, 1998), communities of learners (Rogoff, 1994), and knowledge-building communities (Scardamalia & Bereiter, 1994) are three frameworks that have considerably influenced the learning sciences research and educational practice. Though they have some nuanced distinctions, they share three fundamental tenets: Activity, Participation and Enculturation. The active nature of learning is embodied in students' participation in negotiating meanings, developing understanding, evaluating, and orchestrating their own learning in collaborative environments. These forms of participation are, in turn, viewed as processes of enculturation: students assume increasingly central roles in the community, and immerse themselves within a culture of learning through which they acquire competence in language, social practices, rituals, and values.

Interestingly, this shift in education coincides with technological advancements, such as the introduction of the World Wide Web and subsequently Web 2.0 technologies, which reoriented end-user computer interaction from individual work to communication, contribution and collaboration. Thus, there appear to be concomitant and complementary changes in pedagogy and technology. Several technological innovations have been designed to enhance learning processes in communities to streamline particular activities and function as partners in thinking and as agents of enculturation. For example, dynamic visualization tools (Kali, Linn & Roseman, 2008) provide participants with a shared focal point for the explicit external visual display of information, enabling them to visually inspect, comment on, and modify each other's ideas vis-à-vis these representations. Furthermore, some of these tools reflect the ways in which experts conceptualize, visualize and represent knowledge in their disciplines. These specialized tools can guide learners' interactions in accordance with the norms of the discipline (Tabak & Reiser, 2008), and serve as agents of enculturation.

Blurring school-society boundaries to overcome disconnects and divides

Despite the strong educational potential, and the increasing presence of ICT in formal and non-formal educational environments, there is little evidence of an overall positive effect of the use of ICT on the quality of learning. Technologies in education tend to sustain rather than challenge traditional pedagogical approaches. A

number of methods have been adopted to address this limitation, including studies devoted to scaling-up of educational innovations (Roschelle, Tatar, & Kaput, 2008), engaging in participatory design with schools (e.g., Penuel, Roschelle, & Shechtman, 2007), and in forming research-practice partnerships (Kali et al., 2008). At the risk of oversimplification, we suggest that these approaches share a focus on disseminating learning environments that were designed from a school-centered approach.

We are proposing a new tack—partnership between scientists in the field of the social sciences and in education to create a productive synergy between the study of ambient and designed technology-enhanced communities. Educational science has much to offer on the ways in which representations and participant structures can effectively advance specific learning goals. However, this understanding is mostly applicable to the existing structures of schooling with rather rigid, hierarchical definitions of student and teacher roles.

In contrast, social scientists examine the ways in which people adopt these technologies in their daily lives. They primarily take an analytic stance and study, without explicit intervention, the numerous virtual communities that interact using social networking platforms (e.g., Facebook, Twitter), or Web 2.0 platforms (e.g., Wikis, Blogs) without any overt educational intention. In this way, social scientists can offer important insights into the means by which "crowds" can self-organize in pursuit of shared information-based goals, building on ideas such as Schelling's (1978) classical notion that micro-motives of individuals create macro-behaviors in a society. Network analysis techniques enable characterization of the structure of communities in technology-enhanced endeavors such as Wikipedia or YouTube. Other advances in the study of social networks have uncovered how these entities are characterized by power law distributions (Barabasi & Albert, 1999), rather than the more familiar normal distributions. This, in turn, raises questions about the nature of expertise, access and equality, and about whether there is room for more intervention in order to address these new sources of potential inequity. Studies of online communities in the social sciences can further help us understand the inherent motivation to engage in social media, and the impact that this has on identity and social well-being (Elias & Lemish, 2009).

The understanding that the social scientists glean from the study of ambient technology-enhanced communities is a powerful force in directing our attention to learning that may occur incidentally within online communities, offering new interpretations of learner interactions, and inspiring new ways of conceiving of designed learning environments. At the same time, educational research offers important new directions for social science research. In particular, it provides theoretical frameworks and methodological approaches for fine-grained analysis of the development of specific knowledge structures. In addition, social scientists may be motivated to a more interventionist stance to enhance the study of equality and digital divides. Despite the strong potential for the cross fostering of ideas between the educational and social sciences, a key question is whether educational scientists, who focus on the interventionist design-based study of learning, and social scientists, who focus on the analytic study of ambient social interaction and knowledge construction, can engage in a productive collaboration. We believe that the answer lies in adopting a shared focal point for our collaborative research lens.

Co-creation of knowledge: Bridging school-society, educational-social sciences

We focus our collaborative investigative lens on the notion of co-creation of knowledge (Lewis, Pea, & Rosen, 2010). This reconceptualizes learning from a school-based, individual acquisition of knowledge and skills to an ongoing process of the production of knowledge through joint activity. This also repositions the study of ICT from a dichotomy of "educational" versus "generic" tools, to a streamlined study of the role of technology in the co-creation of knowledge across the various contexts that comprise an information-based networked society.

In adopting co-creation of knowledge as our focus, rather than the conventional view of learning as an activity accomplished in schools (and other intentional, circumscribed environments), we view it as an endeavor that occurs throughout the day and across the lifespan; people continually engage in collaborative activities within different communities and for a variety of purposes. In some cases, knowledge goals may be more clearly specified and directed, and in other cases they may be more loosely defined and emergent. For example, in a secondary mathematics classroom, students and teachers annotating a digital textbook may have the specific, institutionally-specified goal of achieving a basic understanding of the nature of mathematical functions; but these same students, later in the day, while communicating with other youths and adults throughout the world about methods for determining the top achieving players on a Massively Multiplayer Online Role-Playing Game (MMORPG), may derive shared insights concerning statistical analysis techniques, without having this as a pre-specified, intentional educational goal.

Adopting the same lens to understand the processes in both education and social sciences highlights the research prospects that lie beyond the artificial pitfalls and blind spots that may have constrained past studies of ambient and designed learning environments. More importantly, it diminishes the boundaries between schooling

and society, opening the door for extended conceptual frameworks that can help minimize the school-society digital divide, and better equip citizens for lifelong learning in an information-based networked society. In the following sections we describe seven LINKS studies that illustrate how education and social sciences complement each other, and how the ambient-designed continuum can contribute to our understanding of learning in technology-enhanced communities.

The role of social network tools in the integration of immigrant students into academic life

Meital Amzalag, Nelly Elias, and Yael Kali

Students of Ethiopian origin belong to one of the weakest and poorest groups in the Jewish population of Israel. These students face social and cultural gaps in addition to economic hardships and racist stereotypes. The present study seeks to examine whether social media, and specifically social network groups, used by students to communicate course issues, could provide social, cultural and educational resources for their integration in the Israeli higher education system.

This poster represents part of a larger research project, which will gradually progress from no intervention at all, i.e., examining spontaneous processes in the *ambient* arena, through a series of minimal intervention stages *designed* to take advantage of the social media to support these students' integration processes. As such, the first stage of the research consisted of observation of the learning processes as they occurred spontaneously, while in the second stage students were told about other courses where students have established their own social network group to communicate course issues. Through this second stage, we examined (a) who were the students who became members of the Facebook study group; and (b) how students of Ethiopian origin have participated in that group, as compared to students from the majority group. The findings are based on a survey of 136 students from the majority group and 36 students of Ethiopian origin, and an analysis of 28 posts from the Facebook study group opened by students.

A significant digital divide was found in the spontaneous stage between students of Ethiopian origin and students from the majority group, which was reflected in their lower usage of internet in general, and of study groups in particular. Students of Ethiopian origin were not aware of the advantages of internet resources for advancing their academic goals and social integration. Findings from the second stage indicate that these students' pattern of participation in the study group was peripheral and limited to passive observation.

Lessons learned from the ambient to the designed arena: The minimal progression from the totally spontaneous setting towards the designed study enabled the examination of patterns of participation by students of Ethiopian origin in online social media. Next stages will use a design-based research methodology to explore means for supporting the integration of students of Ethiopian origin in the Israeli higher education system.

Designing future learning spaces based on ambient analysis of epistemic socialization

Uzi Brami and Iris Tabak

In this poster, we draw on an ambient setting analysis to present an initial design framework for the support of epistemic socialization in history in a future learning space (FLS). Epistemic socialization is the process through which classroom interactions influence learners' views about knowledge in the domain of study (Tabak & Weinstock, 2008). A case study of the epistemic socialization in a university introductory history course (Brami, in preparation) revealed continuities and discontinuities between views of historical knowledge and classroom practices. We use these to identify practices that advance or hinder mature views of historical knowledge.

One example is the continuity between views of history and note taking practices. Nascent views consider written accounts of the past to be certain, while mature views consider these historiographies as possible justified versions of the past (Wineburg, 1991). Students in the course used shared "master notes" of a classmate. Students with nascent views perceived these notes as an account of the class lectures as well as an account of the past, and considered their accurate transfer to the exam a formula for success. It seems that nascent learners view the past, historiographies, the lecture and "master notes" as versions of the same canonical text. Thus, reframing the class notes from a canonical to a contestable text could pave the way to viewing historiographies as such. Changing note taking practices from an exclusively learner activity to a joint teacher-learner activity can create a third space where note taking is guided, subject to debate, and is part of the formal script of the classroom. Note taking and other practices of learners who held more mature views, and literature on learning in history, inform the design of tools that structure and support the process of analysis, critique and corroboration. The shared notes will be displayed on the FLS wall mounted computer screens. We will study the

role of features such as the prominence and omnipresence of these displays in epistemic socialization. The poster presents the main findings from the case study and an initial design framework for an FLS-based curriculum in history.

Lessons learned from the ambient to the designed arena: This poster draws on an *ambient* setting analysis to present a *design* framework for supporting epistemic socialization in FLS-based history curriculum.

Designing network support for online discourse based on ambient group communication studies

Carmel Kent, Esther Laslo, Sheizaf Rafaeli, and Ayelet Baram-Tsabari

Asynchronous online discussions are commonly used to support collaborative learning in both fully online and blended higher education courses. While online discussion holds a promise for learning and collaborative knowledge building, there remains a challenge. The opportunity to share ideas, learn from peers, and build knowledge collectively in virtual settings is the promise. Yet, in practice, online discussions often do not meet engagement expectations. Contributions are frequently disjointed or not responsive, and discussions may become shallow and incoherent.

This poster represents a synergistic study that combines educational psychology and learning sciences theoretical roots of socio-constructivism and collaborative knowledge building, with theories and frameworks from the field of knowledge management and information sciences, such as perceptions on group communication and interactivity (Rafaeli, 1988). With this joint research lens, we propose a focus on shared and dynamic construction of knowledge during a discussion, using semantic network structures for the discussion instead of the classic thread-based discussion structure. For this purpose we developed Ligilo, a peer learning online platform for networked based discussions. Ligilo enables learning communities to create collective concept maps through discussions. Ligilo provides a hyperlinked learning environment, where the relations between content items are generated collaboratively and connections are made explicit.

The system was used during 2014-15 in several academic institutions and study groups in different settings. Field studies were conducted to evaluate the learning afforded by the semantic networked online discussion forums. Initial research insights shed light on the process of collaborative knowledge building, and the new roles of learners and teachers in learning communities. For instance, initial evidence shows that interactivity level was directly affected by the structure of the discussion, the request to relate new contributions to other students' contributions, and to explicitly tag those relations. Additionally, teachers used Ligilo's tools to manage (or delegate management of) the discussion towards their instructional goals, thus shifting their pedagogies into more learner-centered, rather than teacher-centered approaches.

Lessons learned from the ambient to the designed arena: Building on a theoretical framework that was developed by studying *ambient* computer mediated communication (Rafaeli, 1988), this research developed an innovative TEL environment to support online discourse in a *designed* setting. The lessons learned from the ambient to the designed arena include qualitative insights regarding interest, argumentation and knowledge types, as well as quantitative measurement of metrics regarding outcomes, learning behavior, sharing and interactivity at the community and individual levels of learning.

Scientific literacy in public media reader comments as interpreted using curricular lenses

Esther Laslo and Ayelet Baram-Tsabari

Education for informed citizenship, knowledge-based decision-making, and application of scientific ways of thinking to everyday life are the main goals of the science literacy movement (Ryder, 2001). In today's networked society the internet is the public's primary source of science and technology related information. Social media is ever more prominent in this landscape as a provider of both science-related information and opinions, and as enabler of bottom-up engagement with and deliberation on science-related issues.

This poster presents a study in which expressions of scientific literacy in reader comments in a leading online news site (Ynet.co.il) were sought. Specifically, over a thousand reader comments to articles on animal experimentation and on climate change were analyzed. Based on the definitions above, we view this online reader comments infrastructure as an ambient TEL environment. The contents of the items in this ambient environment were studied using an analytical framework based on a designed learning context - the school science curriculum. The curriculum was chosen as an analytical lens in order to describe how the aims of school science (embodied by the curriculum) are echoed in an authentic public engagement with science setting and its real-world suitability as a provider of scientific literacy. For this reason, the formal Israeli biology curriculum's

definition of scientific literacy was adopted, encompassing scientific knowledge, perceptions of the nature of science, scientific skills and structuring an informed position.

Our findings show that over half of the scientific concepts used by the commentators are at the high school or academic level, in which science is elective. This means that even if all the people taking part in the discussion took elective science (an unlikely assumption considering the percentage of those choosing to study science) than in order to take part in the discussion or follow it passively as readers, members of the public need to learn many new science concepts independently—probably from the media. We also found that expressions of scientific literacy do not necessarily go hand-in-hand with the scientific consensus. Many times scientific knowledge is used to support different individual beliefs which are at opposition with the scientific consensus.

Lessons learned from the designed to the ambient arena: The environment investigated is an authentic example of lifelong learning and the application of science literacy to everyday lives of the wide public. Methodologically, it demonstrates how lessons learned from the *designed* arena (the conceptualization and operalization of science literacy in formal science curricula) may be used to explore authentic processes in an *ambient* environment such as reader comments in public online media.

Promoting teacher professional growth for technology-enhanced outdoor inquiry teaching

Keren S. Levy, Yael Kali and Tali Tal

Inquiry in the outdoors may promote cognitive, emotional, and social aspects of science learning, however, teachers face various challenges while implementing this approach. Mobile technologies may provide some solutions, yet teachers need support in developing the knowledge and skills required to successfully integrate these technologies in their teaching.

This poster presents a unique professional development (PD) program that applies a "Teachers-as-Designers" (TaD) approach (Voogt, McKenney & Kali 2014), in which teachers are engaged in collaborative design of learning materials. Our intervention involved 24 teachers of environmental sciences, who used a TEL environment we designed, which integrates mobile applications to support outdoor inquiry. As part of the program, teachers worked in collaborative teams to design a similar learning environment for their students, by customizing a replica of the environment they used as learners. The study examined the potential of the TaD approach to contribute to teacher professional growth, with a specific focus on the integration of technology in outdoor inquiry teaching. Data sources included: observations in the PD program, quantitative measures regarding teachers' activity in the team websites, and interviews with nine teachers.

In order to follow teacher professional growth, data were analyzed using the Interconnected Model of Professional Growth (Clarke & Hollingsworth, 2002). Findings indicate that all teachers developed their knowledge and ways of thinking regarding the integration of technology in their teaching, and some demonstrated professional growth as reflected in long-term changes in their classroom practice (referred to as growth networks in Clarke and Hollingsworth framework). For instance, changes in teachers' practice (reflected in the design of the websites during the PD), led to changes in their personal domain (e.g., higher self-confidence), which further led to long-term changes in their school practice (integration of collaborative documents to enhance collaborative learning) months after the PD ended.

Lessons learned from the designed to the ambient arena: This poster demonstrates how the use of a theoretical framework of professional growth can track the change sequences in teachers' learning from their experiences in the *designed* environment (during the PD) to their continued learning and practice in the *ambient* environment (in their school practice, long after the intervention was over).

Tracing the emergence and growth of epistemic norms in a designed TEL community

Sarit Barzilai, Dani Ben-Zvi, and Oshra Duek

Epistemic cognition research has highlighted the importance of epistemic standards for evaluating achievement of epistemic ends (Chinn et al., 2014). This poster illustrates how two different research perspectives – epistemic cognition and learning community research – can jointly contribute to the conceptualization and examination of the ways epistemic norms emerge and grow in a learning community. With this dual perspective, we define epistemic norms as socially negotiated standards of what counts as knowledge within the community and of acceptable epistemic practices of constructing, justifying, and communicating knowledge. We argue that emergence and growth of epistemic norms is an essential part of the formation of learning communities and is

critical for achievement of their aims. The specific objectives that guide the current project are: (1) to identify and characterize the epistemic norms; and (2) to trace the emergence and growth of these norms.

This research is set within an innovative, graduate level course that is designed as a technology-enhanced classroom learning community. The characteristics of this learning community include emergent-design, process-content integration, reflective discourse, dialogic-humanistic approach, and use of a Wiki collaborative editing environment. Thus this learning community has an overall design, yet, within this design, both members and moderators take part in shaping emergent epistemic norms as well as shaping the technological and social infrastructures which support these norms. These emergent practices are viewed as ambient within the designed environment. To provide multiple perspectives on the epistemic norms within this setting, this research traces the micro-development of both individuals and the group throughout a semester of study over several years.

To illustrate our approach we report on one epistemic norm identified in our data. This norm maintains that the knowledge created by community members, individually and collaboratively, has a tentative and evolving nature and hence community products can be continually developed. The norm was first introduced in the community by the moderators by explicitly stating that course products can be shared in draft form and repeatedly reworked and was supported by the Wiki technology which enables co-editing of the community website. However, the uptake, re-interpretation, and negotiation of the norm, originally introduced by the moderators, continued throughout the semester as community members struggled with accepting the change in knowledge construction and sharing standards and strove to define and communicate the new norm.

Lessons learned from the designed to the ambient arena: This study examines how both the designed and ambient practices of a learning community jointly contribute to the negotiation and formation of epistemic norms. Examination of epistemic standards through a learning community lens sheds light on the social processes by which epistemic standards arise and attain a normative status, and also elucidates a key component in the development of learning communities.

Dimensions of collaboration on a tabletop interface for children with autism spectrum disorder

Patrice L. (Tamar) Weiss *(Joint work with M. Zancanaro, E. Gal, N. Bauminger and S. Eden)*

Autism spectrum disorder (ASD) is a pervasive developmental disorder which involves deficits in social relationships, communication impairments, repetitive behaviors and restricted interests. Recently, intervention studies to treat the social deficit of children with high functioning ASD (mainly without the use of technology) have adapted techniques of cognitive behavioral therapy (CBT) to help these children engage in more effective interactions with peers as well as to enhance their socio-cognitive understanding of social constructs and processes (e.g., Beaumont & Sofronoff, 2008).

This poster represents a combination of two very different fields of research, namely CBT and CSCL. Specifically, CBT principles and techniques (e.g., problem solving, concept clarification, role play and feedback and behavioral rehearsals), were translated into a CSCL environment -- computer-mediated games to teach the understanding of collaboration through actions and conversation as well as to facilitate children's social engagement with peers while implementing collaborative behaviors during shared actions and conversations. The Join-In Suite, a 3-user touch-based application was implemented via the DiamondTouch mutli-user touch table (Weiss, et al., 2011). The Join-In Suite uses the multi-user capabilities of this device to foster collaboration between pairs of children and to provide ways for a teacher or a therapist to control the pace and process of the educational or therapeutic interaction. The design of the application explored different types of collaborative interaction patterns in a multi-user context: Joint Performance where collaboration is the performance of an action together; Sharing: where collaboration is the sharing of personal resources to achieve a common objective; and Mutual Planning where collaboration is the elaboration and performance of a joint plan. The capability of a multi-user device to recognize the actions of different users allows actualization of these dimensions by embedding them in the operations of the interface. For example, if a play piece is assigned to one child, the other child cannot move it; in order to obtain a successful result they have to play in a collaborative way (in this case, via the sharing dimension).

Lessons learned from the designed to the ambient arena: Field testing has demonstrated that the Join-In Suite appears to have found a delicate balance between the world of gaming (e.g., motivation, excitement, feedback) and the world of therapeutic intervention (e.g., control, empowerment). This balance in the *designed* environment, can assist children with high functioning ASD to develop the cognitive understanding of the social constructs, and ultimately, to more adaptive interpersonal functioning in the real (*ambient*) world.

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