

ABSTRACT

Title of Dissertation: STICKERS CONVEYING YOUTH
INTERESTS: HOW YOUTH USE STICKERS
FOR MEANING MAKING

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While mobile technology has supported and enabled both formal and informal learning, there remain difficulties connecting learners' interests to places-based learning contexts. Place-based and affinity space learning frameworks are useful for understanding and scaffolding learning. Place-based learning looks at ways aspects of the local context/geographical context (e.g., plants, animals, stores, houses, etc.) can shape learning. Affinity spaces, as a learning theory, focuses on the interests and passion that motivate learners and communities. Bridging the interests from affinity spaces with the knowledge from lived environments can help scaffold learners to help them connect their learning to new contexts. Being able to connect learning in new contexts is an important step that currently is not thoroughly described between online interest spaces and place-based learning environments. Technological affordances of mobile technologies (e.g., cameras, apps, GPS, etc.) can provide tools to bridge gaps between learners' interests and lived environments. For example, the always on connection mobile phones have to

the internet allows people to bring their interest communities to new places (e.g., telepresence robots). New technologies thus have great potential for connecting these interest and place-based aspects of children's lives to learning.

My dissertation study explores how to help learners connect their interest-driven learning to everyday place-based learning using technology. An important aspect of this connection centers on how to effectively encourage new lines of communication between learning communities. The specific technology I used to encourage the development of learning communication is digital stickers. Digital stickers, much like their analog counterparts, are used by learners to communicate interests and, importantly, emotion with images. Unlike emoji or badges, stickers have the added affordance of allowing learners to collectively edit or contribute to a single image rather than being a more standard time-based conversation log. Placement, theme, recipient, and other factors provide the technology with the ability to impact and communicate emotional ties and potentially influence more enduring connections between place, interest, and learners. My dissertation specifically looks at (1) how members of the Science Everywhere informal learning community currently connect place and interest and (2) how the *affordances* and *constraints* of digital stickers impact usage of these stickers with respect to connecting and communicating learning interests. Analysis of this data examined factors that impact design of digital stickers or potential similar technologies when connecting interests from affinity spaces to place-based learning environments.

STICKERS CONVEYING YOUTH INTERESTS: HOW YOUTH USE STICKERS
FOR MEANING MAKING

by

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Chapter 1: Introduction

Educators often seek to guide youth in their informal *Science, technology, engineering, and mathematics* (STEM) learning explorations. Connecting these interest-driven explorations is a complex process that often seeks to connect STEM learning content to potential interests of the learners. When educators seek to assist youth engagement with life-relevant learning, they often begin by connecting the subject matter with individual interests from youths' everyday lives. Understanding the context of individual youths while they learn is important to assist youth with connecting learning to their everyday lives (Ito et al., 2020). Making these connections to their lived experiences is especially important for more sustained long-term outcomes such as identity and disposition development (Gresalfi & Ingram Goble, 2008; Gresalfi, 2009). Making these connections between interest and learning resources can be difficult though. For instance, when starting from a youth's everyday, lived experiences it becomes important to ensure they have ways to communicate their ideas while cultivating them into learning experiences. Communication of their interests can be nonobvious, especially if there is little shared contextual knowledge between interest and learning resources. In this dissertation I will examine how stickers – particularly digital stickers – can serve as a way for youth to initiate and illustrate conversations about their interests.

What Are Youths Doing?

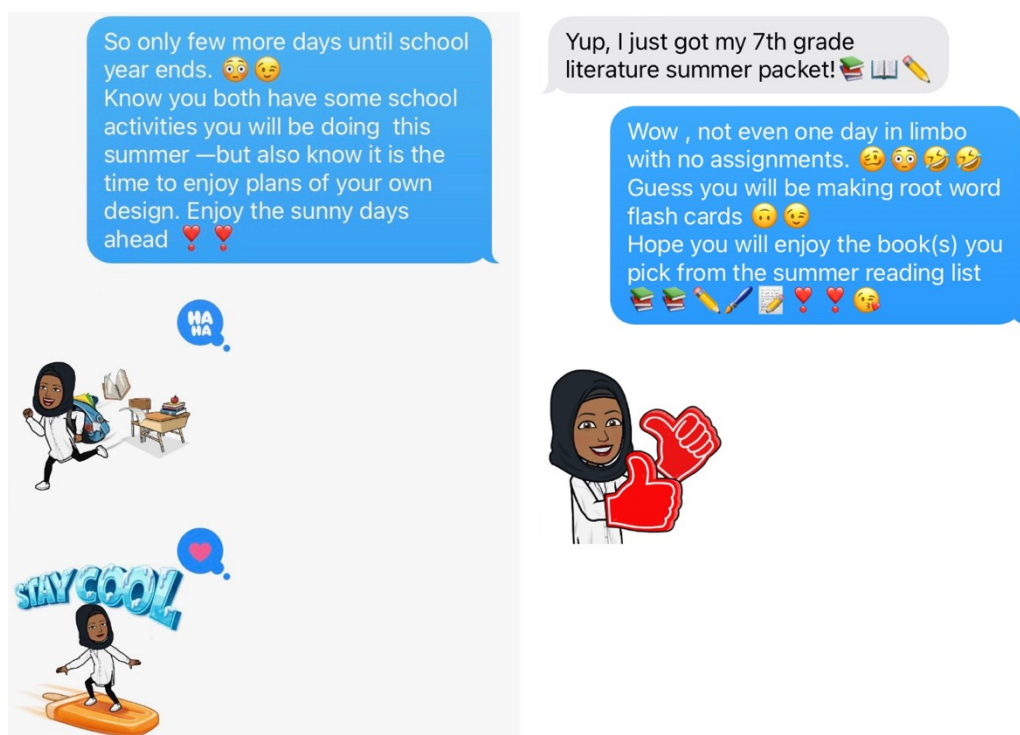


Figure 1: An exchange between a grandmother and her granddaughter using a combination of text, emoji, Tapbacks, and stickers to communicate learning goals. The grandmother's words are in blue, while the granddaughter uses customizable stickers to respond.

One way to take youth identity and disposition into account is to look at how youth are interacting and communicating in their everyday lives. Once an educator or facilitator observes the ways the youth are communicating potential learning interests, they can then leverage those communication norms to promote learning (Ahn et al., 2014). Sharing images online has become an increasingly prevalent and important way in which youth communicate with their peers and families (Duggan & Smith, 2013; Anderson & Jiang, 2018).

Sharing images online goes beyond simple sharing of photographs. Youth today are using significantly more visual means of communicating in general (e.g., emojis and memes) (see Figure 1). Therefore, we need to better understand how youth are using these visual means of

communicating so that we can help them use these communication practices to support life-relevant learning (Clegg et al., 2012). We need to understand the ways that visual or pictorial communication can provide valuable information for supporting learning practices. These communication norms impact practices such as information seeking behaviors by youth and resource management roles by parents (Wilson, 1999).

Everyday Context

If we are to understand online visual communication practices of youth, we must also understand the offline, or “real life”, contexts where the youth live, learn, and develop while engaging their interests. One important step for evaluating these contexts is to understand how youth engage with place-based learning. Connecting place-based contexts not only helps to engage participants with learning but it can also help with things like retention of participants in communities (Halpenny, 2010). For instance, it has been shown that connecting math learning to everyday youth interests, such as playing basketball, increased engagement with the learning content (Nasir & Hand, 2008). These youth interests also connect to and frequently are a core part of virtual worlds (Duncan & Steinkuehler, 2008).

Historically, the focus of place-based learning has mostly been limited to the immediate details of a place and content knowledge or associated practices, with less focus on the interests and related skills that youth bring with them. Hence, place-based learning approaches have historically run into difficulty connecting to the diverse interests that participants bring to a place, beyond their interests in the details of the place itself. For instance, earlier work on how to use mobile technology looked at social interactions children were having in the context of outdoor connections to nature (Land & Zimmerman, 2015). Unfortunately, these uses of mobile

technology often do not fully account for the participants' knowledge and skills that exist outside of the place context. Without accounting for the interests of the participants, design considerations for mobile-technology could potentially lead to the assumption that the participants all have the same interests or that their interests do not influence their engagement – or disengagement – in a place. My dissertation looks to connect the spaces youth inhabit with their individual interests.

My research looks at better understanding how stickers acting as visual communication modes can provide useful information about youths' everyday life contexts. By understanding these connections, we can assist youth in leveraging their interests while using learning resources available to them. Prior research has looked at some of these visual communication norms with media and ways to explore such methods (Literat, 2013). Research has shown how youth use emojis as a shared language to express emotion and interest (Alshenqeeti, 2016). Emojis are also being used to convey important tonal information and to solicit empathy. For instance, the Bing chatbot, Sydney, uses emojis effectively when describing the rules that govern not only the responses but the “persona” of the chatbot¹. This example of using emojis to help create a persona for the chatbot highlights the potential power of using semiotics to communicate emotion. In layman's terms, semiotics is understanding not only the meaning of a symbol but the context that is important in the creation of that meaning.

Another way to illustrate complicated ideas is using memes. Research on memes has looked at both how youth leverage memes while they spread interests and ideas among peer

¹ See article for example of AI using emoji to convey ideas: <https://stratechery.com/2023/from-bing-to-sydney-search-as-distraction-sentient-ai/>.

groups as well as how youth leverage memes as a tool for self-reflection (Liou & Literat, 2020; Penney, 2020). Yet more work is needed to understand the patterns associated with how both youth and their parents or adult learning facilitators can use these image-based forms of communication to create and share meaning.

What are Stickers?

In this study, we focus particularly on a new digital technology: digital stickers. Digital stickers are much like traditional, physical stickers. They are essentially iconic representations of physical stickers that exist in the “real” world. Both types of stickers allow a user to place an image on top of another object. Digital stickers are, at the moment, somewhat limited to being used in apps such as chat clients, where they can be placed on top of text, images, or other stickers.

Digital stickers have specific affordances that suggest they could support new forms of communication patterns among youth and new ways for youth to connect their interests with their learning focused environments. As seen in Figure 1, stickers can be used in chat applications. In that particular example the youth used Bitmoji to customize an avatar with their facial features, skin and eye and hair color, and clothes. The stickers were then auto-generated, giving the youth a selection of pre-generated stickers with different poses and expression to illustrate different things they might want to communicate. Stickers can also be placed on top of images or text as seen in Figure 2. Digital stickers also come in prebuilt and non-customizable packs you can download so you do not need to create your own stickers, similar to buying a pack of physical stickers at a store.

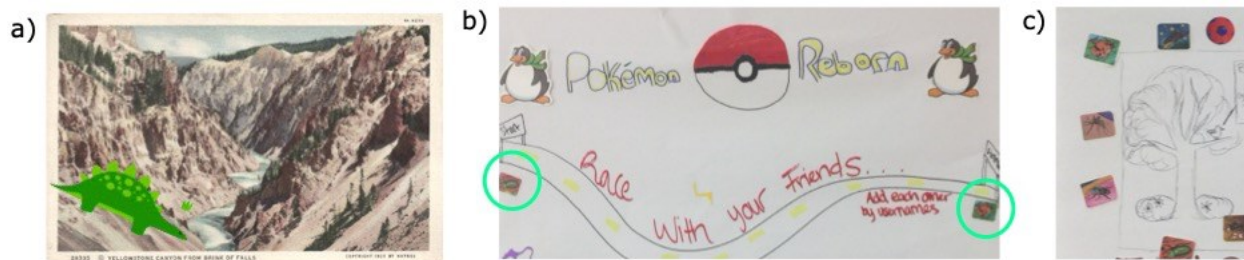


Figure 2: a) An example of how people could use physical or digital stickers to convey interest by putting a dinosaur on a postcard (lower left). Prior work b) and c) also showed participants using stickers while designing technology.

There have been some examples illustrating the potential importance of digital stickers and how they could positively impact everyday learning. For instance, it has been shown that digital sticker usage can help during the creation of a digital identity (De Seta, 2018). Stickers can also be used in more immersive augmented reality environments to assist youth exploration (Su-ju, Liu, & Bing-Cheng, 2013). While these sticker focused studies focused on platform-specific innovations such as augmented reality, to my knowledge there has not been a study that uses stickers to connect the concepts of everyday learning, such as promoting identity and disposition development, with learning interests of youth. I will show how stickers might assist with youth communicating interests in their everyday contexts.

In this dissertation, I explore the affordances and aesthetics of stickers that youth use to convey their interests. I also examine the interaction experiences stickers promote among their social and family groups (e.g., friends/peers and intergenerational relationships). Specifically in this dissertation, I explore the following three research questions: (RQ1) How do youth describe and discuss **stickers** with respect to the **interests** stickers could convey in an informal science learning context, (RQ2) How do the **constraints and affordances** of sticker design impact **sticker usage patterns** of participants while sharing and exploring their interests, and (RQ3) How do real world **interaction dynamics** between youth and parents in community settings

impact **sticker usage**. Understanding how digital stickers are utilized in social, online environments will help those facilitating the youth's learning to adapt digital stickers to support interest-driven learning in face-to-face learning environments. Specifically, stickers serve as a kind of in-between zone between the structured, emotional language of emoji and the more freeform expressions of interest of memes. Stickers having structure in the form of packs while being able to potentially be customized or even created by youth themselves – rather than a standard body like emoji – present an opportunity to build a new way of communicating between youths and their older generations.

Summary of Methods

While I have proposed that digital stickers provide a practical and contemporary opportunity to study how to connect interests from affinity spaces to the lived opportunities of place-based learning, it is important to understand how youth understand their interests as being reflected in a sticker. For my research, I have used a participatory design method to include youth learners in the design process of stickers to better understand how they might connect an interest to the meaning of a sticker. Involving the learners in the design process has been shown to provide insight into what youth think about designs and how they would use them in a learning environment (Ahn et al., 2014; Yip et al., 2014).

There are many forms or methods of participatory design for creating inclusive technology that have different advantages and disadvantages (Kensing & Blomberg, 1998). For this study, I specifically used cooperative inquiry as a subset of participatory design. Cooperative inquiry groups are diverse, featuring multiple disciplines where team members of different ages engage other team members in learning about what they are designing (Druin, 1999).

Importantly, cooperative inquiry emphasizes designers and other adult stakeholders partnering with children. This diversity is necessary to design for the inherent diversity of affinity spaces.

Cooperative inquiry includes a variety of techniques, such as Bags of Stuff – a low-tech prototyping technique where children create concrete designs with various craft materials such as pipe cleaners, cardboard, and felt (Clegg et al., 2013). However, for this study I will be primarily using Layered Elaboration – an ideation technique using transparencies on top of screenshots/designs that allows children to iteratively build on one another’s ideas (Walsh et al., 2010). Other sessions include designing in situ during a learning session such as Kitchen Chemistry, where youth and their parents work together to investigate chemistry while cooking (Yip et al., 2012). This session was integrated with digital stickers as a way to explore how stickers can be structured and used in an informal science learning setting. Sessions also were followed by interviews afterwards to discuss the sessions in more detail with youth and, if applicable, parent participants.

The specific context where cooperative inquiry took place is that of the informal science learning program Science Everywhere. Science Everywhere emphasized leveraging technology to support informal STEM learning across community contexts in the everyday lives of youth (Gubbels, Yip, Kim, & Ahn, 2013; Bonsignore et al., 2014). Child participants in Science Everywhere have engaged in cooperative inquiry about new technologies. In addition, during informal science learning experiences they talk about their interests, including those that relate to affinity spaces. Since Science Everywhere is an intersection of cooperative inquiry and informal science learning, the Science Everywhere program provides a useful research context to explore

how to design and use digital stickers to connect interest-driven learning with place-based learning environments.

Summary of Conclusions

In this dissertation I will show how stickers can be used to illustrate or highlight youth interests. I will then detail how stickers are used by youths and their parents to communicate ideas such as learning interests. While discussing usage, I will introduce the concepts of *sticker vocabulary* and *sticker grammar* to help explain how information is organized by youth and parents when communicating using stickers. These descriptions of usage patterns are useful when helping to scaffold stickers into already existing interaction dynamics between youth and their parents or among community members in an informal science learning setting. My dissertation uses these concepts to show how stickers and the contexts in which they are used can be designed to connect interest to place-based learning resources. Stickers work as easy to pick-up ways for people to communicate symbolically while also creating opportunities to playfully begin to explore ideas from youth interests.

Chapter 2: Research Questions

RQ.1) How do youth describe and discuss **stickers** with respect to the **interests** stickers could convey in an informal science learning context?

- a) How do youth envision stickers representing an interest?
- b) How do youth connect their interests to place?

RQ.2) How do the **constraints and affordances** of sticker design impact **sticker usage patterns** of participants while sharing and exploring their interests?

- a) How do patterns of sticker usage suggest a vocabulary for stickers?
- b) How can *sticker vocabulary* be used to combine ideas and create rules for a *sticker grammar*?

RQ.3) How do real world **interaction dynamics** between youth and parents in community settings impact **sticker usage**?

- a) What motives or roles of parents might influence or guide their sticker usage with their children?
- b) How do youth and parents' digital ecosystems and preferences influence their motives for using digital stickers?
- c) When stickers are scaffolded in a community setting, what strategies do youth and parents use to understand and explain their use of stickers?

Chapter 3: Literature Review

In my study, it is acknowledged that youths and their parents already have deeply engaging interests that they participate in as part of their everyday lives. The goal of this study is to assist with the exploration of these interests in their everyday lives by using stickers as a symbolic means to communicate. While the specific context in my study focuses on a STEM learning environment, the contributions related to how stickers can be used could also have more broad implications for learning pursuits. To frame an understanding of youths' interest-driven engagement I draw on literature in the fields of *affinity spaces*, *placed-based learning*, and *semiotics*. *Affinity spaces* as a framework describes how online spaces are created and run by participants while exploring and sharing their interests. *Place-based learning* is a particularly large field of study. I will be focusing primarily on the concept of everyday learning with an emphasis on informal and home learning environments. My research primarily focuses on impacts of and contributions to the foundational theories of *affinity space* and *place-based learning*. These impacts will be informed by framing stickers as symbols with interest-based meaning. *Semiotics* is a field that looks at signs or symbols and how individuals and groups assign meaning to these symbols. I will specifically be using semiotics as a way to describe how youth and parents can use stickers as symbols while communicating about the youth's interests. Understanding how youths and their parents assign meaning to stickers, including factors such as general placement or what stickers are placed on top of, can assist connecting youth interests from their affinity spaces to place-based learning resources.

Affinity Spaces

To start looking at the interests of youths we need to understand where these interests are currently being explored. Affinity space theory describes a rich context where people discuss and engage with interests that they are deeply invested in. In this first section of the literature review I will use literature from the field of affinity spaces. Affinity space theory accounts for those interest-driven spaces that usually exist online. I will first describe the rich (usually online) contexts that support interests. Next, I will discuss how online spaces are important communities where youth can develop and explore their interests, including some key aspects of how people create and organize the spaces to support their interests. I will then look at how people already connect their interest to other places and spaces. This will also include a discussion of some of the limitations in how to connect these interests to contexts that may not fit under the affinity space framework, such as informal, place-based learning settings.

An Online Playground for Interests. It is important to describe the spaces where interests are being explored. Affinity Space theory is focused on describing these mostly online spaces. Affinity spaces are where people share and contribute to a common affinity, interest, or subject. Affinity spaces allow people, in all their diversity, to come together around common interests and contexts (Gee, 2005). The focus of affinity space theory is different than the focus of similar theories that look at how groups of people organize themselves, such as communities of practice. Communities of practice focus on collaboration based on common methods while affinity spaces represent a diverse setting that is not defined by practices (Barton & Tusting, 2005). Essentially, in affinity spaces learning is defined by the interests of the individuals collaborating. This is facilitated by the unique languages, symbols, and expression used in the

spaces. Since the space is defined by community-specific language, this often times requires understanding the specific interests to effectively connect different affinity spaces (Gee, 2005).

Interests can be described as facets of an individual that they want to learn about and/or contribute to (Barron, 2004; Gee, 2000). Integrating science and technology learning interests using mobile technology requires understanding not only the learning, but characteristics of the spaces where these interests exist. Navigating these networks where interests are expressed can be a complex process (Martin, 2012). These interests existed even before the rise of ubiquitous internet connectivity. For instance, Pokémon has a strong community based around the general interest in the Pokémon franchise. While my study does not focus on understanding Pokémon, Pokémon being a relatively old interest space provides a rich case study of an enduring space with considerable learning opportunities. Pokémon has adapted to new technological spaces several times, as it existed prior to current mobile technology – the franchise was created in 1995. Pokémon has been shown to be a healthy learning community where individuals can learn about and contribute to a wide variety of practices (e.g., math, writing, and drawing). The fact that Pokémon has endured for so long as a franchise with a healthy community that learns as the franchise changes over time has shown that successful learning communities often include diverse ways to interact with parts of a larger interest (Vasquez, 2003).

Democratized Engagement with Interests. In this study, I look specifically at affinity spaces when connecting to everyday learning practices. It is important to understand how individuals in an affinity space can not only view or consume media related to their interest but also have the option to become contributors and more actively engage with their interest. There are previously described factors that contribute to more affinity spaces for learning that are

useful to consider when working to connect interest and everyday learning. My study focuses on the specific affinity space factors of 1) democratization of participation, 2) transformation of knowledge, 3) distribution of knowledge, and 4) inclusive feedback (Gee & Hayes, 2012). Democratization of participation refers to anyone being able to contribute to the community, regardless of background, beyond the role of passive observer. Such participation is necessary for knowledge to be transformed constantly by the interactions between community members. Not only is the information transformed through interactions, but the information is also distributed among the community. In other words, no one in the community holds the entirety of the information. Finally, inclusive feedback is necessary to make this information network function, as not only can anyone contribute but anyone can potentially impact the organization of the community itself. These are key factors of enduring affinity spaces that can be shared by place-based learning. These factors will be focused on when examining the designs produced by the Science Everywhere group where I conducted my research.

My study approaches how to *connect interests from affinity spaces to the context of place-based learning* by looking at communicating science learning and interest in informal affinity spaces. Historically, communication in place-based settings has been focused on accountable talk, primarily in formal learning environments (e.g., schools), to teach how to communicate science in a similar way as academic or professional scientists. While the format of more traditional scientific communication has been applied to science education standards (NGSS), research looking at how to create enduring connections between formal learning institutions and informal science communication used in more interest-driven spaces is often more focused on how to adapt specific interests into the formal vernacular than how to adopt

more informal ways of communicating (Mathie & Cunningham, 2003). Understanding how people communicate their scientific learning in spaces that are not focused on specific practices presents a challenge due to the fundamental shift away from more practice driven to interest driven communication (Gee, 2015b). My study looked at how to scaffold the beginnings of this communication from interest to scientific practice, at the start using the more visual language of digital stickers.

Describing Backchannels for Engaging with Interests. In this study, I explored the use of digital stickers as a visual medium youth can use to communicate within affinity spaces, as well as communicate the interest outside of these spaces. My work informs our understanding of how such visual communication means can support engagement. While some efforts have been made to involve interests from affinity spaces into formal learning settings, direct implementation of an affinity space into place-based learning environments has proven to be difficult. Most affinity spaces research has looked at and focused on text-based means of communicating (e.g., backchannels, discussion forums). This difficulty connecting interests between spaces is a limitation of affinity spaces with other contexts that could include needed resources such as an informal learning environment. One aspect that could make it difficult to connect an affinity space direction to place-based learning resources is how fluid membership in an affinity space can be. Affinity spaces primarily emerge from a convergence of diverse people in a unique context partially of the communities' creation. Understanding of the context of an affinity space requires constant change, due to the rapid iteration common in affinity spaces in general. This creates a situation where an initial connection might be sufficient to provide an initial burst of interest from an affinity space to a place-based learning environment. However,

such a burst may not keep up with the interest to create a more enduring connection. One potential factor is that current instances of linking interest to place-based learning do not sufficiently cover multimedia communication practices that are vital for affinity spaces (Curwood & Magnifico, 2013). Further study is needed on how to use technology to allow for communication in these contexts.

A factor contributing to the difficulty of connecting affinity spaces to place-based learning communication is the relative short life span of affinity spaces due to shifting interests. For instance, while a franchise such as Pokémon acts as an affinity space, it has many smaller individual sub-communities serving different groups. These smaller communities, being more specific in nature, often do not last as long as the larger community. As an example, while Pokémon Go served as a unique affinity space and was successful, the number of individuals in the affinity space has dramatically decreased over time (Kawa & Katz, 2016). Overall, online spaces can have extremely rapid turn-over. This high turn-over poses a problem for connecting to place-based settings that require more time to implement a learning technique. By the time the place-based environment plans and implements a connection to a specific affinity space there is a possibility that the specific space may no longer be popular or may be completely shut down.

In effect, the flexibility of affinity spaces to match the diverse interests of the people in the community also creates problems when connecting to place-based learning environments. It is not sufficient to design a technology around a specific or static connection between affinity space and place-based learning site (Lammers, Curwood, & Magnifico, 2012). Instead, we must understand how communities design a technology for affinity spaces without designing overly rigid affordances – to avoid designing for a group that no longer exists.

Essentially, to achieve these longer-term connections to interest, it likely is not sufficient to merely allow for increased amount of youth contexts to try to connect interest to a place-based practice. Stronger or more responsive connections between contexts, including understanding of the unique languages of a space, are needed beyond an increase in choice to allow for connected learning. Technology may help fill a role to connect these spaces due to the omnipresence of mobile technology in the lives of youth (Benson, 2011). However, mobile technology has created a situation in which a single place-based context cannot be assumed. Many diverse interests are now able to co-exist in places due to mobile technology and social media. Technology has been increasingly giving individuals and groups this ability, whether it is playing music on a portable cassette player or filming a video to share with others at a different location. Attempts to make use of these new technologies in learning environments have been met with mixed success. Learning environments have yet to fully adapt to the transformative ability of technology to link multiple place contexts (Steinkuehler & Squire, 2009).

While digital stickers do not constitute an affinity space, visual ways of communicating can be a central component of an affinity space. Examples of this include platforms such as Flickr and Instagram that are websites where users share photos. In Flickr, the community discusses photos and related content, various techniques or even the symbolism of a photo. The Flickr and Instagram communities are not fully explained by the practice of taking photos and are not limited to the practice of photography – e.g., Pokémon communities are not singularly focused on how to play the Pokémon video games. Instead, photography serves as a medium for discussion and can include examples of users sharing their individual values with images. Effectively, the images allow for some intersection between places, interest, and social

collaborative learning (Davies, 2006). These examples of image-based communication communities point to how a visual language can potentially serve as a nexus for communication for interest driven learning. With this practice of connecting interest and places using images such as photos, I will dive deeper into how meaning can be assigned to symbolic imagery to communicate interest between places and spaces.

Place, Learning, and Context

Having discussed how affinity spaces work as a lens to describe youth interests, I will explain the value of connecting these interests to the everyday lives of the youths using a place-based approach. My dissertation focuses on the connections between interest and space being illustrated with stickers. For instance, youth participants in my prior work described harvesting place specific resources to feed a Pokémon or taking a Pokémon to a real park to use the playground equipment to train and make the Pokémon stronger (Figure 3). The design session with the high school participants pointed out some important design considerations for future technology. Youths' desire for more information about the places where participants were engaging with their affinity space (i.e., Pokemon Go) shows that the participants did want to engage in place-based learning and connect it with their interests. This interest-focused connection was especially apparent in the designs where participants could highlight a physical place and integrate it back into the game or activity from their affinity space (Figure 3, Figure 4) (Pauw, Warrick, Boston, Preece, & Clegg, 2017). While the designs did not all focus on social interactions or social learning, the ones that did showed the importance of having scaffolding to help facilitate face-to-face interactions to connect them to both the place and the interest.

Another strategy they used was to facilitate social, face-to-face interactions that are connected to physical places such as a basketball court (Figure 4).

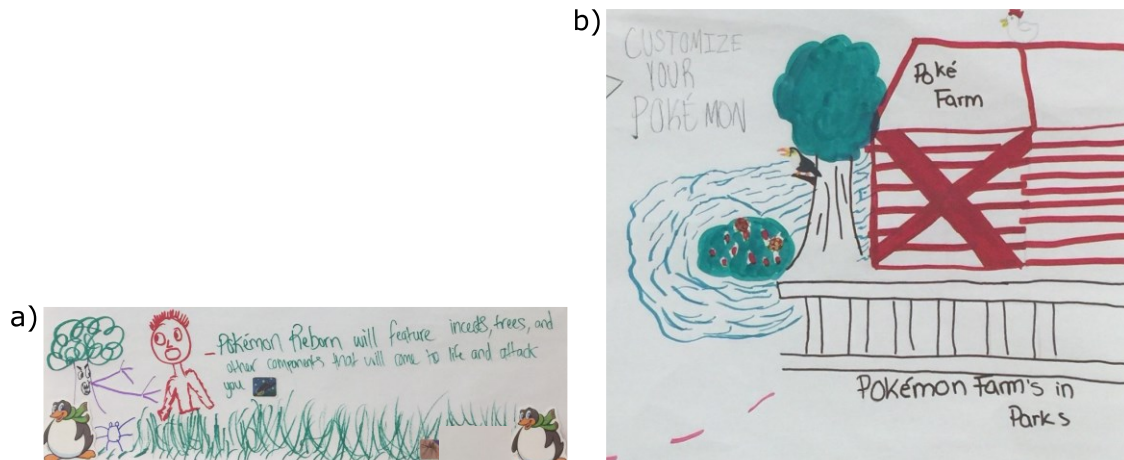


Figure 3: These designs connect to physical places by representing the places in Pokémon Go by a) imbuing the trees or other features with action, such as trees attacking you if you go to a forest at night and b) turning parks or other recreational areas for human

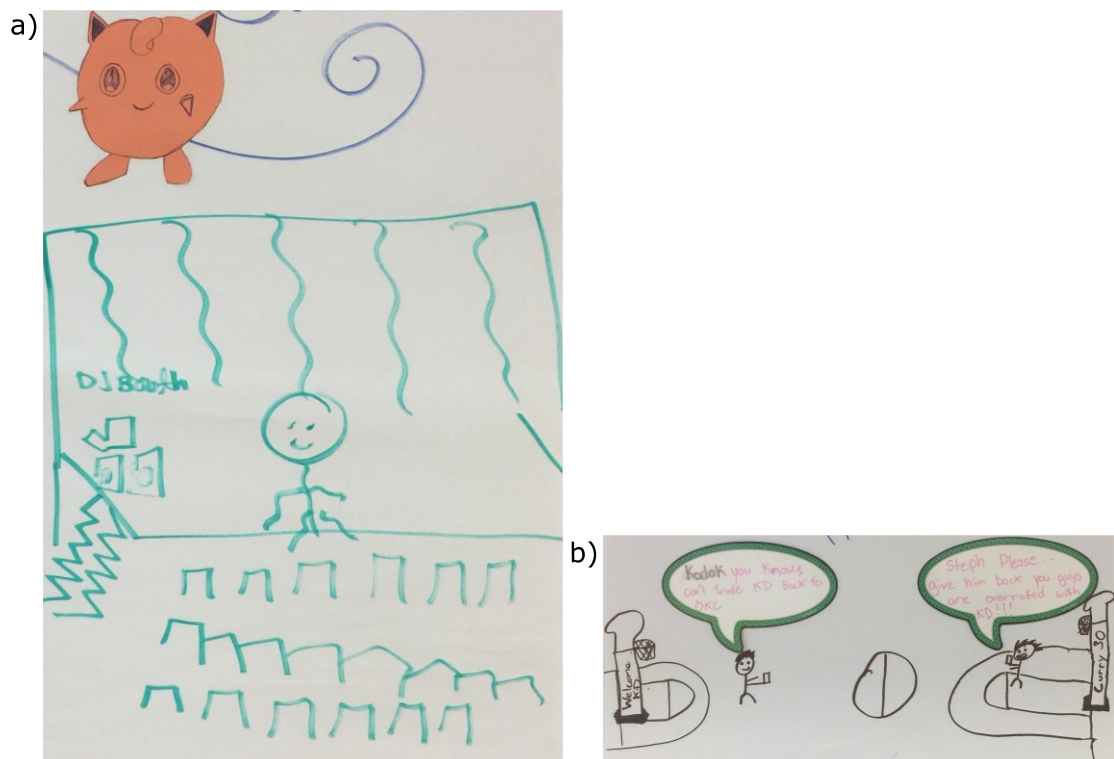


Figure 4: a) In “Live Show”, community members interact with the local environment to gain an audience in the app and then put on “shows” for the audience at a place in their community. b) In “Ball Trade Collect”, participants collected and traded different basket

These examples required detailed information about not only the interest but the place. To understand how digital stickers could support youths' everyday learning, we need to define and understand what that everyday learning is to them. Essentially, what are the everyday places that support youth learning and how is this learning supported? It is important to understand the contextual impact of the everyday places, such as basketball courts, and how people interact on them. In this section, I detail the importance of everyday learning as a type of place-based learning, some limitations in previous attempts to connect affinity space interests and place-based learning, and important social factors to consider when connecting everyday learning opportunities to interests from affinity spaces.

The Places of Everyday Learning. To frame such understandings of youths' everyday learning environments, I draw on place-based learning literature focused on everyday, informal learning environments. For the purposes of this dissertation, place-based learning situates the importance of understanding the nuanced aspects of the contexts in which youth are engaged and the ways in which these contexts influence and support youths' interest-driven explorations. With respect to place-based learning, my research focuses on the practical impacts of technology using currently deployed technology that participants could use in their everyday lives. The connection to places is important even for more informal learning. For instance, prior work in the field of citizen science has shown that everyday science practices can be used to teach interested participants while also gathering data about the environment (Haywood, Parrish, & Dolliver, 2016). Additionally, I will discuss how technology can also be used to encourage participants to engage in everyday practices (e.g., taking a picture of a bird and logging the time to gather data) to learn more about the science that is related to their interests (e.g., bird conservation). While

my dissertation will not be directly connected to citizen science – nor measuring learning outcomes – citizen science provides an interesting example of combining interest with everyday, place-based learning.

Conservation citizen science connects participants with the study context by helping them to gain or refine skills. These studies rely upon understanding prior knowledge and how it is linked to the citizen science project. It has been shown that place-based learning occurs in these settings. Participants in these conservation projects increase their prior skills and knowledge related to the practices of the place and project. While these citizen science projects help engage people in learning place-based science, these studies can also be somewhat limited. Historically, citizen science has found difficulty when recruiting long-term participants from a diverse set of backgrounds and knowledge (Haywood, Parrish, & Dolliver, 2016). My research seeks to engage people in ways that encourage longer-term connections between their interests and scientific practices.

Learning about the context of place not only helps to engage participants with place-based learning but it can also help with retention of participants in the community (Halpenny, 2010). Place-based learning in citizen science projects has been shown to impact the identity of participants in addition to their conservation behavior. Changes to the participants include increased attachment to the place and result in those participants acting upon their knowledge of the natural environment (Halpenny, 2010). This connection seems to indicate the importance of interest for learning and the effective use of the knowledge. While increased ability to learn and act in science learning contexts are positive outcomes, mobile technology provides greater ability to connect learning across contexts. For instance, technology can be used to help enable people

to share information about their learning while being a citizen scientist (Masters et al., 2016).

The learning component is vital to the citizen science projects because without it the participants would have less success in their role as citizen scientists due to lack of knowledge of their context and practices used by the field (Haywood, 2013).

Historically, the focus of place-based learning has mostly been limited to the immediate details of a place and content knowledge or associated practices. Practical implementation of place-based learning has historically run into difficulty connecting to diverse interests of the participants and not just the details of the place. For instance, earlier work on how to use mobile technology looked at social interaction but mainly focused on the acquisition of scientific language for future research, taking family contexts into account (Land & Zimmerman, 2015). While the socio-technical tools described connect youths to specific contexts of the place, they do not account for the participants' knowledge and skills that exist outside of the place. Without accounting for the interests of the participants, design considerations for mobile technology could potentially lead to the assumption that the participants all have the same interests or that their interests do not matter. Therefore, my research attempts to account for the interests and spaces they inhabit and not just the immediate place-based learning environment.

Contextual inquiries can assist in the exploration of these interests by focusing on explorations that are linked to the learning environment and usually include some connections to popular interests or to detailed, real-world practices. For example, in informal contexts, boyd explains teen usage of social media (boyd, 2007) and, in formal contexts, Chinn and Malhotra's work examines how to see and promote youths' scientific thinking (Chinn & Malhotra, 2002). Interest-based contextual inquiries have been shown to lead to youths connecting to science and

becoming more engaged in their own scientific learning (Price & Lee, 2013; Yip et al., 2014; Land & Zimmerman, 2015). Contextual information about the learning environments is necessary to connect youths to practices beyond simple learning behaviors (Clegg et al., 2023).

Social Everyday Learning Places. Place-based learning situates the importance of considering the ways that contexts influence the social interactions and experiences in a place. Place-based learning seeks to connect history and important practices specific to the place to learning. Technology that looks to connect the context of a place to learning has primarily focused on connecting prior knowledge of people in that place, or youths to the practices they are conducting in a place. Youth place-based practices are an important aspect of these communities because they help define activities that participants need to learn to effectively interact with an important goal of a place (Hoadley & Kilner, 2005).

Concrete examples of place-driven practices would be learning how to test water quality for a nearby polluted river or learning about the historic importance of a community building and how it was built. A non-profit group we have worked with for prior research, the Anacostia Watershed Society (AWS), connects participants' everyday lives to the Anacostia River watershed that they live within. Connecting something like a watershed to everyday lives can require a different way of thinking about the places they exist in (i.e., most don't normally think about the river that all the water in the street flows into when they're walking down a street). This historical information helps to connect everyday learning opportunities with learning about subjects such as water quality and how people in the Anacostia watershed can contribute to their communities (Clegg, Preece, Pauw, Warrick, & Boston, 2016). Additionally, by extending the learning beyond just how to preserve the watershed they can connect to more diverse groups of

people who can learn and contribute to the community. With this need in mind, technology that looks to the context of place seeks to better define and connect a community of practice with the context of the place (Zimmerman & Land, 2014). Ultimately, by connecting people to the details of a place we have more opportunities to engage people in learning beyond a limited set of practices.

The importance of mobile technology goes further than just the example of citizen science, of course. Mobile technology has created learning environments in which a single place-based context cannot be assumed. Many diverse interests are now able to co-exist in places due to mobile technology and social media. Technology has increasingly given individuals and groups this ability, whether it is playing music on a portable cassette player or filming a video to share with others at a different location. Unfortunately, attempts to make use of these new technologies in learning environments have been met with mixed success. Learning environments have yet to fully adapt to the transformative ability technology has to link multiple place contexts (Steinkuehler & Squire, 2009). In my dissertation, I focus on how mobile technology can assist with social dynamics that can be present in place-based learning environments.

One way to think about social interactions around learning is to look at research related to third-space theory that describes places where humans can engage in creative interaction with each other (Oldenburg & Brissett, 1982). Third-space can be used to describe the fusion of physical place and remote spaces that participants may use. By considering the advantages of third spaces we can start to see ways that place-based learning settings can be connected to everyday learning contexts. Learning doesn't just happen at home or work (e.g., school).

However, prior attempts to connect spaces directly in formal learning settings, while initially successful, did not result in long-term interest in the place-based learning (Benson, 2011). To achieve longer-term connections to interest, stronger or more responsive connections between contexts, including understanding of the unique languages of a space, are needed beyond an increase in choice to allow for connected learning.

Technology may help fill a role to connect these spaces due to the omnipresence of mobile technology in young youth's lives (Benson, 2011). For instance, can usage of a more playful and symbolic communication method like digital stickers connect to or even promote an atmosphere that allows for the mixing of ideas that happens in a third-space? There is insufficient research into how digital stickers could work in such an instance. We do not know all the factors that impact mobile technology, let alone digital stickers, that could support such a bridge between interests in a place or space. My dissertation looks to expand upon the affinity space and place-based literature to better describe how a symbolic medium like digital stickers could assist with youth when they are communicating their interests.

Connecting Affinity to Place

I have provided some examples of how it is beneficial to connect interests to place-based learning. One way to make these connections is seen in the example of citizen science. Citizen science programs can provide examples of the importance of place and how it can connect to learners' interests. However, it is not necessarily as easy to make connections to youth interest in every instance. Prior theories that look at community learning, such as Communities of Practice and Communities of Interest, focus on a limited scope of practices or interests that is not reflective of broader learning spaces that exist outside of home and work. Previous attempts to

connect people to place-based learning beyond focusing on a practice have included looking at bridging formal and informal learning contexts using language (Gee, 2015a). However, these efforts to connect verbal and written language do not always effectively connect youths to the place-based learning environment. Evidence-based reasoning is not limited to formal learning settings and has been demonstrated to occur in a variety of interest-driven spaces. Limiting the media to written or verbal communication that is usually specific to scientific practice often does not account for how youth might use other ways to communicate their interests. For instance, visual communications are a frequent, if not the only, form of communication in some communities (e.g., Instagram, YouTube) (Gee, 2015a). Accountable talk needs further structure to connect these multi-media communications with evidence-based language.

To address new ways of communicating using visual media, my dissertation is based on prior work asserting that designing mobile, multimedia technology for diverse places necessitates a more inclusive design philosophy. I use co-design, or participatory design, to involve participants in the creation of technology to facilitate their learning in light of the complexity of multiple places and contexts (Machin-Mastromatteo, 2012; Yip et al., 2014). Co-design of methods to communicate learning and interest in the context of the scientific learning environment could help address specific context-sensitive needs. Individuals and the learning community might be better served by context-sensitive technology that accounts not only for their place-independent interests but also for how ideas are increasingly being communicated using multi-media – not necessarily reliant on text-based argumentation (Lankshear & Knobel, 2007). My research focuses on images and interactive, multi-person editing to better make use of the affordances that images can provide beyond text-based, social learning. These stickers were

designed and used by late elementary to early high school participants to communicate their learning interests from affinity spaces outside of Science Everywhere and will be described further in the Methods chapter.

Specifically, my project was focused on youth interactions through technology to help connect their interests to life-relevant scientific learning. The goal was to connect the interests from affinity spaces to learning resources present in the everyday lives of the youths by encouraging communication and sense making using symbols represented with stickers. I explored this transformation of knowledge and interest using participatory design to explore digital stickers design and usage. Understanding how stickers are both used and designed can contribute to democratization, inclusivity in communities, transformation of knowledge, and distribution of knowledge facilitating easier connection of everyday learning interests to youths' place-based learning environments.

Semiotics

I frame digital stickers that communicate interests as symbols, leveraging research from the field of semiotics. Semiotics is a field of the study of signs, the meaning behind them, and the process involved in making meaning (Gee, 2005). Effectively, symbols such as stickers can assist with the sense making process needed to associate youth interests from affinity spaces with the place-based resources such as those provided by their parents. Since symbols are inherently a highly contextual way of making meaning, stickers as symbols could serve as scaffolds to assist with this process of youth and their parents making sense of how to explore an interest.

Specifically, I will be looking at the idea of Semiotic Social Spaces as social places where signs are created and shared (Gee, 2005). The spaces exist to help people organize and

make sense of ideas. These theories are important when explaining how people communicate using symbols or signs. I will then discuss how to think about communicating these symbols and their meaning across contexts. To help describe how symbols like stickers can potentially be used to communicate outside of the social spaces that generate them I make use of the theory of Boundary Objects. Boundary Objects can assist with communicating meaning between the boundaries of interest-based communities (Fischer, 2001). Boundary Objects do this by having some shared usage of an object where some amount of the meaning of the object can be transferred or shared.

Finally, I will discuss how stickers work in this framework. I will provide a practical example of how stickers can be used to communicate meaning. This discussion of stickers as symbols will provide some ideas for how stickers could be used to connect interest from affinity spaces to the place-based learning resources of youths. I will also point out some gaps in our understanding and how my dissertation will start to describe ways that youth and their parents might make sense of the meaning of stickers while negotiating and in general communicating about learning activities.

Symbols and Context. Symbols are important because they can provide rich data beyond just an individual's understanding. Despite how it can be tempting to attribute the full meaning of a symbol to an individual's understanding, symbols are implicitly a product of their context (Gee, 2007). Symbols can have different meanings or even no meaning depending on the context. This trait of symbols being linked to the contexts that produce and use them is important because to understand the meaning behind the symbol there needs to be some understanding of the contexts it is in.

As previously mentioned, the interests of youth also have important links to contexts such as online spaces. Interests have a great deal of cultural or contextual information that they are dependent upon. Symbols also have this contextual dependency. Essentially, to have a discussion of the symbols you must have some amount of discussion and understanding of the context they're from and are being used inside of. In a sense, encouraging the use of symbols and the discussion of their meaning can potentially help transfer some of that context with it (Feldman & March, 1981). Indeed, this concept of language being useful for understanding the development of identities of youth has been well discussed (Gee, 2000; Lemke, 2001; Lemke, 2002; Heyd-Metzuyanim & Sfard, 2012).

Transferring Symbols between Contexts. As previously mentioned, language needs context to effectively convey information. Understanding the language used for learning in informal spaces is no different. Looking at more flexible ways of communicating ideas and their context, such as with visuals like images or video, is important as these media can help participants' communication of their learning online in affinity spaces, as well as in place-based learning environments (Gee, 2004; Lindgren, 2012). Therefore, to be able to start to understand communication between affinity spaces and place-based learning environments, I seek to better define the specific interests and how they can be conveyed between these spaces.

Connecting interest and place-based learning is akin to connecting people from disparate communities of practice. Connections are necessary due to gaps in language, shared practices, and membership. In other words, a person who is a member of the Pokémon Affinity Space may not understand how to communicate with a park ranger in a national park about Pokémon Go, such as what a specific type of Pokémon has to do with specific features of a park. Boundary

objects are tools used by two communities (e.g., Pokémon and Park Rangers), though not necessarily in the same way. They can serve to help transfer or communicate information across community boundaries. Digital stickers fit the description of a boundary object because they have flexibility to describe new concepts but with the precision to still communicate information between community boundaries (Star & Griesemer, 1989)

In the Pokémon Go study, participants created and used stickers as boundary objects to express their designs and ideas while connecting to their interests. Stickers can be used by different communities of people but in different ways. For instance, one person can use a sticker of a water type Pokémon to communicate their interest in Pokémon and place it on a map next to a river to communicate to a teacher that they would expect a water type Pokémon to live around a river (Fischer, 2001). While the discussion of how we make meaning is important, it isn't necessarily straight forward to discuss meaning between contexts. For instance, it is easier said than done to communicate important contextual detail about an interest from an affinity space like Pokémon to the place-based informal learning environment of your home with your parent who knows nothing about Pokémon. This illustrates the necessity to better describe and understand stickers so that we can effectively use them to communicate between contexts.

My dissertation is motivated by research helping youth to engage with and develop their identity and dispositions around science (Nasir & Hand, 2008; Ahn et al., 2014; Clegg, Ahn, June, Yip, Jason C, Bonsignore, Elizabeth, Pauw, Daniel, 2016). Prior research has suggested the need for artifacts, tools, and language that helps people from different communities and backgrounds to communicate. These artifacts, tools, and languages can be described as boundary objects. Prior work has looked at boundary objects for connecting communities of practice (Star

& Griesemer, 1989; Wenger, 2000). The classic example is maps being used to connect amateurs and professionals in a community of practice. Maps are used to communicate information effectively between different communities who share a common goal (Star & Griesemer, 1989). In this study, I'm leveraging stickers as a new type of visual boundary object for how people will use stickers to communicate information about their interests and learning. Essentially, stickers can be viewed as a tool to communicate across participants' affinity spaces and the place-based learning environments in Science Everywhere.

It is important to consider that boundary objects as a theory is focused on community or organizational level communication (Star, 2010). The theory was not developed with individual communication in mind and symbols in general reflect context and not just individual understanding (Gee, 2007). As such, my study is not looking at participants' individual learning progress, as digital stickers will not be an effective tool to communicate specific learning of content knowledge or process. Instead, digital stickers are a way to communicate interests and ways to connect to place-based learning. Digital stickers can be used to transparently allow for people in the community to impact the direction of learning in their communities (Wenger, 2000). Stickers as a way to communicate their interests might then provide youth with more agency in their learning, which is necessary for affinity spaces to nurture learning.

Another important aspect of the boundary objects framework is in its positing that symbolic objects are not automatically effective at communicating learning interests and knowledge between people. For instance, it has been shown that when a boundary object becomes less about communicating interests and ideas in a community, boundary objects can become a tool to enforce a power structure independent of the learning objectives (e.g.,

homework as punitive measure for inappropriate behavior rather than leveraging homework as tool to help practice a concept a child is learning in class). When this happens, the boundary object is no longer as effective at communicating learning information and instead becomes a tool to communicate immediate power structure (Kimble, Grenier, & Goglio-Primard, 2010). I took this potential pitfall into consideration when designing my dissertation studies. For instance, the digital stickers design sessions used cooperative inquiry practices (Druin, 1999) to avoid becoming overly reflective of already existing power structures.

Stickers for Connecting and Communicating Interests. I am using the framework of semiotics to describe how stickers might empower youth to make their own connections from their interests from affinity spaces to the resources to encourage everyday learning and exploration. Research into how stickers can be used in new digital media is valuable as stickers are beginning to be implemented in mainstream technology. For instance, technology like stickers is also present in 3D environments such as video games. In video games, stickers (aka sprays) are used by people playing the game to quickly communicate visual information such as excitement, taunting, or thanks. Like physical stickers, in these environments people can also connect the sprays together to modify meaning and communicate back (Figure 5). Other technologies in development, such as augmented reality, also seek to help people express abstract interests in association with physical place-based settings. Prior work, such as that done by Holden on the “Augmented Reality for Interactive Storytelling” project, looked at creating technologies or platforms by augmenting, or modifying, physical places with stories or games (Holden, 2015). Unlike the 3D environment example, augmented reality is still in the nascent stages of development and is not readily available or accessible, especially to participants in low

SES communities including members of the wider community who are participants in my study. While my study looks to better describe the base factors involved in connecting affinity space and place-based learning using visual communication, insights gained from studying stickers could be relevant, if not directly applicable, to the 3D game or augmented reality space in the future.



Figure 5: The video game Overwatch has a version of digital stickers called “sprays”. People in the game use these stickers to playfully communicate with each other. Examples include a) decorating a Christmas tree with sticker ornaments representing the character using a combination of 5 stickers. (Images from reddit.com/r/overwatch community.)

While we can see sticker-like features being used in online spaces, prior attempts to use technologies that children are already using have mainly resulted in only short-term gains in engagement in learning when connecting interests to place-based learning (Azevedo, 2013). Simply employing technology used by a popular affinity space (e.g., YouTube) is likely not sufficient for long-term or even mid-term impacts. In a study looking at youth literacy, when a previously unmotivated youth was given the option to turn a writing assignment into a multi-modal project, the immediate excitement quickly diminished once the participant realized the assignment had not fundamentally changed with the inclusion of non-text media (Benson, 2011). We need to better understand how to facilitate youth engagement beyond the initial usage of the technology in a new context. By using participatory design, I sought to uncover and begin to

explore factors that will help with longer-term engagement between affinity spaces and place-based learning contexts (Bonsignore et al., 2014).

My dissertation focuses on how stickers can act as a visual language for communicating youth interests. Much is still left to be described about how stickers would operate for communicating interests for youth. For instance, stickers could be used by visually over-laying interest on top of already existing place-based learning communications (i.e., they put a sticker on top of an image of learning in a place) or some other combination of place and interest objects. I will detail digital stickers as a communication tool – how youth see them and make meaning with them. I will also describe some strategies for how the meaning of stickers can be understood, particularly when parents and youth use stickers together.

Chapter 4: Methods

My dissertation, while part of the wider Science Everywhere informal science learning project, focused specifically on the design, implementation, and analysis of stickers using co-design methodology. The core data collection in these studies was focused on uncovering how youths and their parents expressed interests that could be connected to learning opportunities through symbols using stickers. The data from the design sessions in future chapters will be primarily presented using case study methodology in the context of Science Everywhere (Yin, 2003). Science Everywhere was a research program run out of locations at the University of Maryland - College Park and the University of Washington. In addition to having locations in two different states, the program also involved different kinds of learning environments. Specifically, the Science Everywhere program was focused on minoritized youth in resource-constrained communities. The two programs both had community partners, including both formal and informal learning environments. For my study, I was focused on the informal learning environments that were part of Science Everywhere. The Science Everywhere program ran for 7 years. My dissertation data was collected during years 4-7 of the program after a core group of participants had already been recruited to the Science Everywhere program – enrollment into the Science Everywhere program did continue over the course of the programs 7 years, though. I planned to do sessions across the two geographic locations where Science Everywhere was run at the time to get a better sense of how stickers might be used in different informal learning environments. However, these plans changed as my dissertation

progressed with data collection (see the Conclusion chapter for reasoning behind changes to the methodology).

Science Everywhere was a research program that supported everyday learning of youths in their local communities. The goal was to help engage youths and their parents with science while having them assist with the design of a combination of technology including a mobile app and a big screen located at community partners including schools and community centers. The goal of the research was to use a combination of technology and community partnerships to help develop scientific dispositions in youth (and their parents) to help increase scientific identities. The technology was designed using participatory design, specifically cooperative inquiry (Druin, 1999). My dissertation focuses on one community in this larger program as a way to explore the development of stickers to assist youth with communicating ideas around their interests. My study was integrated into the Science Everywhere session including similar methods and gathering data from the participants.

The unit of analysis of my dissertation is an informal science learning community of youth and their parents who communicate with one another using mobile technology. Using rich data of focal youths in an informal science learning environment I will describe the affordances and constraints that stickers provide as a communication medium. Helping youths in science learning contexts to start to connect their interests to learning opportunities is an important way to encourage growth of scientific dispositions (Borda, 2007; Ahn et al., 2014). My hypothesis at the start of the dissertation study was that stickers provide a way to engage youths while they begin to develop their understanding of the language and content knowledge required to effectively communicate their interests in the context of informal science learning. I will first

outline the general session methods, participant demographic data, and the associated limitations. I will then go into specific data collection and analysis methods used in the RQ1, RQ2, and RQ3 chapters.

Overview

The data collection methods primarily focused on participatory design sessions that produced design artifacts related to sticker design and usage while investigating the participants' views about the design, in this case of stickers, and their interests. These session transcripts and artifacts were triangulated with interviews of participants to better understand the ideas behind the data from the sessions. Facilitator field notes and session video data from the various sessions were also consulted to provide contextual detail of the session that might not have been present from the transcripts. The design sessions were approximately 3 hours in length and took place during Science Everywhere sessions. Prior to the design sessions, additional information was also gathered by survey where participants ranked and provided feedback on potential platforms for the future deployment of the stickers. From this survey information, Apple's iMessage platform was chosen for the Science Everywhere specific sticker pack deployment and in the studies overall. The iMessage platform was chosen based on the youth already using iMessage to communicate with their parents and iMessage having stickers. While the Science Everywhere sticker pack did not receive much usage from the community, it was valuable for understanding the importance of personal interest when it came to an individual's selection of stickers.

In general, the groups in the design sessions consisted of 3-6 participants. Additionally, interviews with focal youths (see Table 1) identified during the session and interviews with one of the youth's parents were done to collect further data related to the session and help triangulate

the data (Merriam, 1998). Focal youths were compensated for their participation with an Amazon gift card. Additionally, digital sticker packs on the iMessage platform were purchased for youths and provided to them via gift code to use on their personal devices as part of the journaling they participated in (see section on Sticker Journaling for more details on the journaling methodology). Youth participants ranged from 13-18 years old. Youth participants were selected from the overall Science Everywhere population (see Table 2) based on a combination of factors: interest in using stickers, access to mobile technology that can use digital stickers in iMessage, and desire to take part in post session interviews. Additional youths from Science Everywhere (Destiny, Jamie, Ana, Booker, Damien, Amelia, Elena, and Regina) took part in the design sessions but were not identified as focal youths in RQ1 and RQ3. RQ1 and RQ3 focused on group interaction dynamics between peers (RQ1) and parents (RQ3). Focal participants were used for these chapters to provide a cohesive illustration of youths using stickers to communicate interests with different people.

Table 1: Focal youths and parents. Note: families E and F dropped out after first session and I did not have a opportunity to interview a parent.

Family	Name	Category
A	Sierra	Parent
	Jasmine	Child
	Sabrina	Child
B	Maria	Parent
	Antonio	Parent
	Isabel	Child
	Juliet	Child
C	Kalani	Parent
	Naomi	Child
D	Luna	Parent
	Aurora	Child
	Celio	Child

	Nova	Child
E	Enrique	Child
F	Marcos	Child

Table 2: Participant numbers from Science Everywhere at time of data collection.

Adult		Child	
Male	Female	Male	Female
25	33	77	85

RQ1

Describing the interests of these youth in an informal science learning setting was important to the overall goal of my research, which was to understand how youth can use stickers to help communicate their personal learning interests. This study design is based on the understanding that learners' everyday learning interests can be diverse and won't necessarily be connected to a formal learning program (i.e., schools). Specific details of these informal interests are needed to understand how youth could potentially use stickers to explore and communicate important aspects of their interest. It is important to have some understanding of youths' informal interests and how they could in part be communicated symbolically to better connect their everyday interests to learning goals. In this dissertation, I will use the analysis in RQ1 to develop implications for the design of stickers and how they can be used to help children communicate their interests. These implications for how stickers and interest can be connected will be important as I further explore how stickers specifically can be used by youth to communicate.

My goal is to help the youth to communicate their interests in a way that they are more comfortable with, by giving them some control over how they express their interests. This goal underlined the first sub question of RQ1 which asked *how youth see stickers as being able to*

represent or communicate an interest that they have. The *Sticker Pack Design Session* was created to see how the design of stickers and then usage of those stickers could reflect youths' interests. Rather than replicating scientific language and its structures the goal was to find ways for stickers to act as symbolic intermediaries that the youth could use to express their interests in a way that feels authentic to their experiences.

An important consideration for the design was that youth interests would ultimately still be communicated in part by the youth in face-to-face interactions. My aim was for stickers to facilitate youths' conversation around and exploration of their interests. Youth may use stickers to initiate a conversation or to literally illustrate concepts that may be difficult to explain due, for example, to requiring some insider knowledge. One potentially important thing youth may discuss is interests that could have connections to learning. Adults, such as parents, who are able to help the youth make connections between their interests and learning resources would thus need to be able to identify those interests. Essentially, this bridges interests from their spaces to resources from places. Understanding how interest can be connected to place via stickers is thus the second sub-question of RQ1 that specifically looks at *how youth described interest and place as being connected*.

Data Collection Methods. The focus of analysis in RQ1 is the *Sticker Pack Design Session* and subsequent interviews with focal youth about their sticker designs. The design session was done to better understand how youth would visualize and illustrate their interests while designing stickers. The *Sticker Pack Design Session* provided a structure for connecting interest to place where the youth would design stickers for their interest in 6 small groups, a total of about 20 total youth including 6 focal youths. The structure of the design session also

explicitly involved communicating by exchanging stickers with another group to better understand how stickers communicate interests between those who share the interest and those who may need further explanation to understand the interest. To help connect the design session to them more personally and to the place of their local community, the stickers were designed over images taken of the youth doing science learning activities from previous Science Everywhere sessions.

The participatory design session replicated the affordances of stickers by using the layered elaboration technique (Walsh et al., 2010). For the *Sticker Pack Design Session*, stickers were drawn overlaid on an image and then the image was passed on to the next group so they could repeat the procedure by drawing new stickers on top of the previous ones with a new transparency layer. Images were selected from activities that the child participants had taken part in (e.g., prior summer session activities) and from interest related events (e.g., of the participants playing games in Science Everywhere). During the share-back, groups discussed their stickers, how they applied them, and what they thought of the stickers created by other groups. Facilitators grouped designs by common themes and shared back observations to the group.

All sticker and session data for all groups was analyzed and qualitatively coded. The two groups of focal youth that were chosen, the older group of participants in the design session (approximately middle school aged), also had additional interviews after the session. These youth were chosen due to pilot work indicating youth of this age range were able to design, use, and discuss their stickers while talking about their interests in detail (Pauw et al., 2017). The youth were also chosen due to them stating they had some passing familiarity with stickers in general, including usage of digital stickers, as well as their ability to discuss stickers with me

during informal discussions in prior Science Everywhere sessions. The first group made stickers based on the popular video game series Call of Duty (referred to from now on as CoD Group). The second group made stickers that reflected their emotions by illustrating facial expressions (referred to from now on as Expressions Group). Members of these groups were also interviewed. In the semi-structured interviews, the youths were asked to discuss their interests in general, learning interests, as well as how they think their parents view learning interests. These topics were discussed to ground the sticker designs with how the youths talked about these concepts. Additionally, facilitators observed the youth and asked questions as they were designing the stickers to document and better understand the reasoning behind sticker designs. The RQ1 chapter will explore how the groups explored and communicated their group interest while designing stickers (both individually and collaboratively).

Data Analysis Methods. The data collected during the *Sticker Pack Design Session* and the associated interviews were initially analyzed using two deductive coding frameworks based on the theoretical frames of everyday place-based learning and Affinity Spaces. The first framework was used for the interview data and the second for the session transcript data. The interviews done with the focal youth used the codes: Affordance, FalseCognitive, Constraint, MentalModel, Emotion, Ecology, Diad, Solo, Family, Group, SEPlace, Home, School, ThirdPlace, Interest, Shared, and Collab. These codes focused on understanding the ideas the youth discussed when talking about using stickers (e.g., Affordance and Constraint), as well as ways to describe the context of the interests they discussed (e.g., Home and School). These deductive codes were used to code all the interview data. Analytical notes were taken during coding and resulted in new codes of Effort and Confusion to describe when the youth took some

time to describe an idea they might be having difficulty communicating, which was important when identifying concepts where stickers might assist them communicating.

The Design session used another code book that focused on the way the stickers were designed and used. These codes include: Shape, Color, Generic Obj, Interest Obj, Size, Orientation, On Obj, Near Obj, and Obj Type. Codes such as Shape and Color focused on defining when those attributes were focused on by youth designers while codes like On Obj and Near Obj examined placement of the stickers they were designing relative to the object they were discussing. While deductively coding the transcripts, qualitative notes were made based on patterns. These patterns were then turned into new codes !Desc and Story and the data was coded again. The Story code was used to highlight when the youth engaged in group story telling behavior. This was particularly important when designing the *Story Design Session* that was used to gather data for RQ2.

Coding for both books was checked by 2 coders on a sample of anonymized session and interview data. A combination of the coded session transcripts, coded interviews, and design artifacts from the layered elaboration technique were used to highlight design patterns that impact stickers representing youth interest. Furthermore, the analysis of the interviews was used to understand how the youths discuss their interests, including ways they preferred to communicate those interests. For the purposes of illustration, the CoD and Expressions groups were chosen as representative examples of the two main strategies for how stickers helped youth to express their interests using a combination of the stickers they designed on top of photos of them at Science Everywhere.

RQ2

RQ2 focuses on creating a useful description of how youth organize and use stickers while telling stories related to their interests. RQ1 focused on how stickers can represent an interest of a group of youths by looking at how they negotiate designing and using stickers. RQ2 focuses on individual usage of stickers to match preferred story telling styles. These styles are described using the concepts of *sticker vocabulary* and *sticker grammar*. *Sticker vocabulary* as a concept came from observing aspects of the sticker design such as color choice used in RQ1's session to communicate important details. *Sticker grammar* came from observing the way stickers were used when communicating ideas in conjunction with other images such as when using the code On Obj. I use the concepts of vocabulary and grammar as metaphors to explain how stickers can be used to organize information, similar to a language.

RQ2 considers how youth communicate with stickers once they are created, which was covered in RQ1. RQ2 specifically looks at how youth use stickers to communicate a story first to themselves, then to an adult facilitator, and finally to other peers. The direction of youth using stickers as part of a story was influenced by the outcomes of RQ1's *Sticker Pack Design Session*. In that design session, youth frequently engaged in relatively short story sessions retelling either something that happened to them or something they saw. Due to the idea of a narrative story being a common way for youth to communicate with each other, I framed the *Story Design Session* to investigate this further while using stickers. The ultimate purpose of this is to focus more specifically on how stickers were used and what information the youth described when discussing the sticker. RQ2 focuses on where the information is located (i.e., is it a part of the

sticker or a combination of stickers together) and important details to focus on when interpreting stickers as part of a narrative discussion.

Data Collection Methods. RQ2 analysis is focused on a *Story Design Session* transcripts and artifacts as well as interviews with the focal youth from RQ1. Additionally, examples of RQ1's *Sticker Pack Design Session* were used to help provide more examples of how stickers can be designed to take advantage of the usage patterns observed in the *Story Design Session*. The *Story Design Session* involved individual youths as part of a co-design session in Science Everywhere. The youth used physical stickers from a variety of sticker pack options to retell a story or event visually. The youth were given a piece of paper with a thought bubble printed on it where they could represent what they were thinking. They then picked one pack of physical stickers from a preselected range available to them. They used these stickers to tell their story. After describing their story to a facilitator and other youths in their group, the youth then picked a second pack of stickers and used them to augment or add to their story. This sticker usage focused on individual youth telling their unique story that reflected their interest. These data points illustrated how individuals used physical stickers as part of the process of telling a story. The youth also added description either by writing them down or having a facilitator write the ideas down for them (in the case of younger participants) about how they believed they would use stickers to retell a story. From the *Story Design Session*, based on the analysis I picked a number of representative examples of different sticker usage styles that I will use to illustrate the patterns.

Another data source was an *Idiom Activity* that was described by the focal youths picked during RQ1 during a new interview after they took part in the *Story Design Session*. The *Idiom*

Activity involved the youths telling an idiom to their parents – half using words and half with stickers – and engaging in discussion at home. The youth were tasked with picking an idiom and then using a sticker to represent part of the idiom while using words to tell the rest. They shared these idioms with their parent(s) and asked them to share an idiom back. Using the same focal youths from RQ1 as the *Sticker Pack Design Session*, there were paired interviews done with focal youths and a parent to gain insights into the design session and the *Idiom Activity*. These data points enabled an understanding of the use of stickers between parents and children. Thus, it was possible to begin to extrapolate how the observed usage of stickers during the story co-design session from RQ1 could work between the youths and their parents. The interview data also details how both the youths and their parents interpreted the definition(s) of stickers, in other words how they view their *sticker vocabulary*. The *Idiom Activity* and associated interviews focused on youths and their parents selected from RQ1 to provide some coherency between looking at their previous designs from RQ1 and how they used stickers in a more everyday context.

I also use a single example from the *Sticker Pack Design Session* used in RQ1 to better show group usage of stickers. The *Story Design Session* was more focused on individual youths. This single example provides an illustration of *sticker vocabulary* and grammar used in a group context. Working in small groups based on a common interest they placed stickers on top of images of themselves. I specifically describe findings from one group that focused on using animal stickers in combination with photos from Science Everywhere. I use the example of this “Animal Group” as they discussed how they used animals as part of metaphors. Other groups designed some stickers that similarly acted as metaphors for words or ideas. The Animal Group

provided the clearest illustration of using stickers as metaphors while telling a story to facilitators. I use this example to connect the insights about how stickers are used from RQ2 back to the ideas from RQ1 explaining how stickers can represent interests.

Analysis Methods. The literature guided an analysis that uncovered patterns in how stickers were used. I will use particularly illustrative examples of these patterns to aid in the overall explanation of stickers being used to communicate. For RQ2 I once again used the two code books, one for the interview data that in this case included the focal youth's parents and one for the *Story Design Session* transcript data. Coding was done similarly to that done in RQ2 with the only change being the addition of the focal parents of the focal youth in the interview data. Qualitative notes were taken to help analyze patterns from the coding data. The interview, session transcripts, and session artifacts of sticker usage were then used to triangulate the data to find usage patterns. These patterns were focused on styles of sticker usage (e.g., prose and poetry) from the design session. These examples will also illustrate the concepts of *sticker vocabulary* and *grammar* with examples from the analysis. These examples will be supplemented with rich illustrations of actual sticker use from the *Story Design Session*. These illustrations provide a variety of examples that serve to describe meaning behind the use of stickers by each youth.

The concepts of *sticker vocabulary* and *sticker grammar* come from a linguistic background related to the theory of Affinity Spaces (Gee, 2005) as explained in my literature review. While my analysis doesn't provide a structured way to diagram ideas as how you can diagram a written sentence, it still provides interesting insights into the different ways stickers can be used to communicate an idea like a story. Further work will be needed to be able to

describe a more exhaustive list of ways to use stickers to tell a story. However, the insights from the analysis are a good starting point to help direct future efforts that are necessary to better describe the diversity of ways stickers can be used.

Data relevant to RQ2 from both the Idiom Sticker Activity (and related interview analyzed with the second code book) and the *Sticker Pack Design Session* (previously analyzed with the RQ1 code book) were used to further illuminate participants' perspectives of their meaning making during these experiences. These two data sources provided an illustrative starting point to describe how stickers were used by youths to communicate. For instance, one similar strategy that assisted with how to think of stickers as vocabulary was examining how people use emoji as symbols to stand in for words in text messages. A face smiling conveys happiness, a thumbs up conveys approval, or a heart conveys liking something or someone. However, emoji can also have other meanings that are slang or are not always universally shared (Miller et al., 2016; Wiseman & Gould, 2018). In the RQ2 chapter I will go into more detail how stickers were assigned meaning by individual youth. I will also describe the process the youths used to assign and make sense of the meaning of the stickers. Additionally, an understanding of *sticker vocabulary* and *grammar* patterns that will be explored in RQ2 will be used to connect the results showing stickers representing interests (RQ1) to everyday learning experiences and contexts where youth communicate their ideas and needs to their parents that will be explored in RQ3.

RQ3

RQ3 looks at how real-world *interaction dynamics* between youth and parents in community settings impact *sticker usage*. In the RQ3 chapter, I will provide examples from an

everyday-learning setting, a Science Everywhere cooking session with parents and children. This will include details about how both parents and children describe stickers, how they communicate with each other in their everyday contexts, and finally an example of how stickers can be implemented in an informal learning setting. The goal was to better understand how digital stickers can be integrated into already existing interaction dynamics between parents and children.

While RQ1 and RQ2 primarily covered how children and adolescents can use stickers among one another, I look at youth and their parents communicating ideas using stickers in more detail in RQ3. Understanding how stickers can be used with parent and child is not necessarily the same as understanding sticker usage within a peer group and can have different interaction dynamics, such as how parents often acquire materials for their childrens' learning activities. Because of this important distinction between youths' peers and their parents, RQ3 specifically focused on how stickers can be used with youths' parents to assist with their interactions. RQ3 focused on better understanding how stickers impact and are themselves impacted by the interaction dynamics between youth and parents that already existed in the Science Everywhere informal learning community settings. I will provide examples of how stickers were used as part of an informal group science learning setting by youth and their parents. I will also provide insights from interviews with these participants regarding why they might adopt using stickers in the future in their everyday lives. Finally, in the RQ3 chapter I will discuss more formalized strategies used by these family groups that might have helped to facilitate families communicating their learning interests with stickers.

Data Collection Methods. The RQ3 chapter primarily uses data related to a Science Everywhere session, the Kitchen Chemistry Session. The goal of the Kitchen Chemistry Session was to provide a more real-world scenario for youth and parent participants to use stickers to communicate or express ideas. The data from the session was then used in combination with knowledge of already existing interaction dynamics between youth and parents, including parental roles to help facilitate youth communicating their ideas. In the RQ3 chapter I will use a combination of artifact data from the Kitchen Chemistry Session as well as descriptions of the artifacts from post session interviews. The interviews also provide insights regarding how the participants felt about and see sticker usage in general or in specific settings such as at home. Participants were recruited from the previous focal youths and their parents and in some cases included some siblings (also Science Everywhere participants) of the focal youths. By expanding the participants to the entire family this helps illustrate the overall interaction dynamics among the family members. Additionally, two sessions were done, one with multiple families and one with a single family present. While this was due to scheduling conflicts with one family, this additional session with one family allowed me to observe if there was any noticeable difference between a more community focused activity vs a more family activity.

The Kitchen Chemistry Session was similar to other Kitchen Chemistry sessions previously attended by the participants (Clegg, 2010). Groups were assigned to match the family units of parents to their child or children. The groups were tasked with making brownies using an incomplete recipe. The parent was sent to “shop” for the missing ingredients – implicitly putting the parent in a material providing parental role that the parents discussed previously in interviews. Parents would send their children images of ingredients at a makeshift “store” (i.e.,

another room that had a selection of possible ingredients they might need). The youths would then respond back using stickers to communicate which ingredients interested them. This communication was done over iMessage using predownloaded sticker packs on iPads provided to them so that the communications could be recovered without recording personal information from their personal devices. The youths and their parents were free to communicate any way they liked – using stickers, verbal, and written communication – during all other parts of the session. Admittedly, the use of Science Everywhere iPads rather than their own personal devices could have changed behavior, but their interaction dynamics were already modified due to the protocol dictating they only use stickers to communicate during a specific part of the session. The artifacts of their communications on iMessage were also used during the interviews to discuss their opinions about the conversation. In the subsequent interviews parents and youth were interviewed separately about how they interpreted and approached using the stickers to avoid there being a right or wrong interpretation to the sticker. It was important to understand not only how the participant understood the sticker but the process of how they came to that conclusion.

Analysis Methods. The data analysis for RQ3 focused on coding of the post session interviews in combination with triangulating the interviews using artifacts. Due to the nature of the Kitchen Chemistry Session being primarily a Science Everywhere Session rather than a sticker co-design session the transcript data from the session was not coded since it did not match the coding framework (i.e., all discussion was about making brownies). Interview transcripts were coded and analyzed similarly to the interviews to RQ1 and RQ2. Artifacts such as iMessage chat logs included data about when stickers were used and by whom they were collected. Coded

interview transcripts, session artifacts, and other data such as researcher field notes and session video data were used to triangulate and illustrate practical applications of stickers in an informal learning setting. The analysis then led to an understanding of patterns of stickers usage in the already existing parental learning roles. These patterns were framed in such a way as to better understand the needs or motives behind youth and their parents using stickers to communicate in an everyday informal learning activity that they might do at home. The analysis also shows some examples of how stickers were used in their session driven communication vs the more informal “for fun” communication that also happened while they were making their brownies. Overall, the goal of the analysis was to better understand how stickers can be integrated into the interaction dynamics of a family.

Limitations

The study was focused on a narrow pool of participants in a single context and focused on using case study methodology (Merriam, 1998). While this means the results are not generalizable in the sense of the behavioral patterns of the youth and their parents to the general public, the case studies identify important ways the youth and their parents talked about interest and used stickers that help to create a framework to discuss how stickers can be used to communicate interests. An additional limitation is that the participants were members of the Science Everywhere community and likely produced designs related to the Science Everywhere activities and community members. Regarding the sticker co-design sessions, the Sticker and Story co-design sessions made use of physical materials rather than digital tools that could better simulate the social platforms that make use of digital stickers. This decision to use physical prototyping material was done to try to encourage a wide range of design and to avoid biasing

the designs toward an already existing design reflected by popular online platforms. Adult or parent members of the community did not also take part in the *Sticker* and *Story Design Sessions* due to external factors related to the historical organization of the Science Everywhere sessions. This session detail, while helping to provide more focused data on the youth, limited my ability to directly observe parents and their children together using stickers. Parents were, however, participants in the Kitchen Chemistry session used for RQ3.

Chapter 5: RQ1 - Interests Connected to Stickers

In this chapter, I look at the question of how youth communicate interests. When exploring how youth describe and discuss *stickers* with respect to their *interests*, I will focus on two main aspects. I will show (1) how youth envision stickers representing their interest(s) and (2) how youth connect those interests to their everyday, lived contexts such as home or informal learning environment. I explore these connections by examining data from focal youth that were part of the Science Everywhere program. I will show how these youth conceptualize and communicate their interest verbally as well as when using stickers. I will show specific details of the interests of these focal youth to illustrate some examples of how youth could potentially use stickers to explore and communicate important aspects of their interest. The discussion will further explore the different ways these youth communicated their interests. I will expand on these interests by connecting the ways they used stickers previously to suggest how their interests could be communicated symbolically using stickers. The outcomes from this chapter were used in future chapters to help explain the interest contexts of youth while describing more specific ways stickers could be used when youth communicate their interests.

Findings

The specific goal and intended contribution of RQ1 is to describe youths' interests and how they use stickers as part of their communication of those interests. To do this, I will look at interests by describing two groups of youth during the informal science learning co-design session focused on using paper-based stickers to design a suite of digital stickers to communicate youth interests. Specifically, the CoD and Expressions groups approached the task of illustrating

their interests with stickers in two different ways, one by reflecting the topic of their interest as part of the sticker design and the other by using stickers to demonstrate their interest. I will then go into some more specific detail of the interests of the individual youths from these groups to give some examples of individual interests from interviews that could be illustrated with stickers that they designed in the group co-design context.

Media-Based Stickers: CoD Group. During the sticker co-design session, I observed that the CoD Group was primarily focused on using the stickers to almost play with the ideas around their interests. The CoD Group quickly focused on the video game series Call of Duty (CoD). CoD is a “first-person shooter” video-game series composed of many unique games with some direct sequels in the series. These games have both single player and multiplayer components. The CoD Group was mostly focused on the multiplayer parts of the game. Roughly speaking, multiplayer involves a person playing the game online or locally (depending on the specific game) with other people. They then play a game in which they use guns to shoot either other players in the game or non-player zombies, depending on the specific game mode. Different modes have specific goals while playing the game but the gameplay using guns remains mostly the same. Each game in the series roughly follows this framework but can have different feature sets including different types of weapons, which are the primary way the players interact with the game.

Overall, the CoD Group focused on the creation of stickers that reflected objects from the CoD videogame. They then used those stickers with the photos from Science Everywhere to combine their interest in CoD with the place and activities of Science Everywhere. This included scenarios like guns shooting trash but also modifying photos of themselves in Science

Everywhere using headsets from CoD. The details of these stickers are important to understanding the connection between their interest and the informal science learning during Science Everywhere.

The CoD Group was composed of three youths. Two of the youths, Enrique and Marcos, collaborated rather heavily with each other by sharing ideas and working together when making the stickers. The third youth, Jaime, collaborated with the other two but was more independent with his designs throughout the session once the sticker design activity started. This group is of interest to the study because of how directly they integrated the overall CoD affinity space into the creation of their stickers. During the conceptualization and usage of the sticker designs the group explored their interest in CoD while socializing with each other.

Identifying a specific interest. The CoD Group began their discussion of what interest to choose by quickly picking the game series CoD. They then spent some time discussing which specific version of CoD they would focus on when designing stickers. As previously mentioned, there are several different games under the Call of Duty name. Some games are essentially sequels (e.g., Black Ops II and III) while others are more disconnected (e.g., Modern Warfare and Black Ops). The group discussion about which CoD they would focus on specifically included details that impacted the aesthetic and design of their stickers. The group members were able to detail important differences between the two games they focused on, CoD: Black Ops II and III.

21: Daniel So, what's the difference between II and III.

22: Enrique Well, II you can't do a lot of things like in Black Ops III. It's like old.

23: Jaime In III, it's just basically features.

24: Enrique In Black Ops III it's like futuristic. You've got jump boots, jet packs.

After some discussion of the specific details of CoD: Black Ops II vs. III, they were asked to pick one. When making the decision, the youths focused on in-game features they liked the most. For one youth, Enrique, this like was determined by gameplay mechanics and their perceived ability to be more successful while playing the game.

36: Daniel So, why do you guys want III instead of II?

37: Enrique Because in III, I'm used to it, and in II I'd be trying to jump boots, and then I'd die, because I can't jump boots.

[...]

41: Enrique And I like to use the M16.

The other youth, Marcos, expressed a similar sentiment as Enrique but instead of it being more about their ability to not die in the game it was rather focused on their overall familiarity with it.

42: Daniel Okay. Why do you prefer II over III?

43: Marcos Because I got used to the game.

44: Daniel Why are you used to it?

45: Marcos Because for me, it's easier. I like all the guns. I use the M8.

Interestingly, both Enrique and Marcos expressed interest in a specific gun in the game. Both youths seemed to focus mostly on a combination of more specific details like gun

preference as well as more nebulous likes such as familiarity and perceived ability to succeed (i.e., not die). This illustrates that different people may like aspects of an interest at the heart of an affinity space for different reasons.

Highlighting Interest with Color. When the CoD Group started to design their stickers the focus on the specific features of the CoD game continued. In particular, the group members were focused on the aesthetics of the guns, how they looked or how they were shaped. One interesting detail is that the color of the gun was important. Unlike in real life, guns in CoD frequently are colored (including different patterns) with what is called “camo”. One color stood out with the group, the color yellow or gold.

173: Jaime Don’t use that color.

174: Enrique Why? Don’t you want to be rich?

175: Jaime I don’t want to use that color.

176: Enrique Just imagine that color makes you rich. [...] I colored [the gun] gold.

There was a bit of disagreement about its usage, but Enrique wanted the inclusion of this color because of a sense of prestige, or as Enrique put it, the “color makes you rich”. The color doesn’t literally make the person rich in-game. Rather obtaining a gold skin usually requires some achievements and reflects a level of prestige in-game. The importance of color – gold in particular – is information understood by those inside the CoD affinity space but not necessarily by others.

Important Interest-based Objects. Not only was the color of the gun important but the gun was also depicted as being active in the scenario. The gun is a central component of the

borrowed from the image and then modified by the gun shooting it, with the CoD gun being able to remove trash with bullets.

Object Cross-Over from Similar Interests. Interestingly, during the *Sticker Pack Design Session* the interest in CoD was momentarily lost. The sticker pack the group chose to design was centered on the video-game Call of Duty. However, some of the photos they were designing the stickers on top of were showing a previous session when they were playing the video-game Minecraft on iPads.

258: Enrique It's a torch.

259: Daniel It's a torch. So, they have torches in Call of Duty?

260: Enrique Oh, never mind. It's a flashlight.

Interestingly, the act of drawing on top of photos of the youths playing Minecraft resulted in one of the youths accidentally switching to Minecraft from CoD. When he switched to Minecraft, he made a sticker themed to the game, specifically a torch (as in a piece of wood that is lit on fire on one end). When asked if torches existed in Call of Duty, they realized they were making a sticker for Minecraft and changed it to a flashlight instead, since flashlights show up more frequently than torches in CoD.

Interest Themed Personalization. The group eventually moved on to discussing different, non-gun aspects of CoD. Specifically, they added a headset. A headset can be either an in-game item or an accessory used while playing the game, depending on the context. Characters in-game can be depicted wearing headsets. But players can also use headsets with microphones

to talk with each other while playing the game. In this specific example, the headsets were representations of real-world accessories the youths likely used while playing the game.

Enrique and Jaime picked a photo of the two of them playing Minecraft. On this photo they made stickers of a headset on their respective heads. The color gold once again made an appearance – this time the headsets were colored gold.

307: Enrique Add a headset.

308: Jaime Okay.

309: Enrique No, I use gold.

310: Jaime Okay, use gold.

311: Enrique We even drew a line on my head. You remember the Xbox 360 wireless Bluetooth headset you just put in your ear?

312: Marcos And you got a mic right here.

As the CoD group continued to talk about the more personal aspects of playing the game, they also began to modify the images of themselves in a way that wasn't entirely consistent with the game. It was more like they started to customize themselves, almost like creating an avatar.

320: Marcos I did. I had it in my ear

321: Enrique That's not your ear. That's your cheek.

[...]

327: Enrique His eyebrows. Let's color them. Look, look at his eyebrow.



Figure 7: Youth placed stickers depicting headsets for voice communications on an image of themselves while playing Minecraft. Additional stickers are objects from CoD such as bombs and zombies.

Representing Specialized Knowledge of the Interest. The CoD Group also integrated other aspects of the game. These additional integrations often required specialized knowledge of the game beyond the general genre of it being a first-person shooter game with guns. For instance, the concept of “specialists” is a gameplay feature of specific CoD games where the player not only has guns but special abilities (e.g., jump boots as previously described).

385: Jaime Where’s the movement at?

386: Enrique Right there when he uses special.

[...]

468: Beth So, what, do you guys have a bunch of supply dumps or something on your stickers?

469: Enrique No, look, he's using his specialist.

470: Beth You've got a special.

[...]

498: Enrique Exactly.

499: Jaime Wait, nunchuks is a specialist.

500: Enrique No, it's a special weapon.

In this instance the group discussed if something was a regular gun or a specialist gun. This is detailed knowledge and requires some familiarity with the game to understand. Essentially, these specialist abilities involve more advanced and likely more detailed information about the specific game they are referencing, as different CoD games have different specialist abilities (1/24/23).

Using Interest Metaphors in New Settings. As the CoD group finished their designs, they were asked to describe what they had made. Interestingly, the group members describe the combination of the contents of the photo (the photo of the watershed trash removal project) with the CoD stickers almost like a gameplay session.

398: Daniel So, what's going on with this other one? You have the model.

399: Enrique I added this guy throwing a grenade at that tower.

400: Daniel Okay, so he's trying to knock down the tower.

401: Marcos I sent out the lightening streak hitting the four zombies.

In an attempt to engage with the scenario, I asked them about the specifics of the gun, using information about their preferred CoD guns from earlier in the session. They again brought up how the gun has a specific camo. Again, the gun was gold colored.

404: Daniel [...] So, that's the gun you like, right, the M8 or something.

405: Marcos Yeah, the M8-A1.

406: Enrique And I added some gold as the camo.

The CoD Group took elements from the CoD affinity space that could be visualized and turned them into stickers. These stickers were then usable for thematically similar purposes (e.g., guns shooting zombies) while in a different space. Elements of the guns such as color can then provide further information about the interest that may or may not be decipherable by people viewing the sticker. The usage of the CoD stickers hints at stickers being able to communicate ideas about an interest using details borrowed from that interest-based context. I will go into this discussion of cross context usage of stickers in more detail in the discussion.

Place-Based Explanation: Expressions Group. In this section, I will discuss the Expressions Group and how they used stickers to provide new insight about Science Everywhere as a place for learning. This group was more focused on using stickers to highlight details rather in a face-to-face interaction rather than being an explicit illustration of a specific interests. When the Expressions Group was asked to pick an interest or theme for their sticker design, they decided to pick a more abstract element of the internet compared to the CoD Group. Rather than the stickers being reflections of objects of the interest, the stickers were essentially emotional

descriptors that could be used to clarify personal interests. To do this, the stickers that the Expressions Group designed during the session were more similar to emoji. Where the CoD Group designed their stickers after guns or other objects that they enjoyed using as part of their interest in CoD the game, the Expressions group made stickers that they could use to clarify their feelings or emotional state about something the sticker was placed upon. In this instance, the stickers were placed upon photos taken of themselves during a previous Science Everywhere session.

The Expressions Group, in a sense, made stickers to point out interests rather than to directly represent an interest. Effectively, the stickers they ended up designing only enhance or illustrate an interest that is contained in whatever the sticker is placed upon or near. The sticker was used primarily to modify another object. During this description of how the stickers were designed, I will detail the process of how the Expressions Group not only designed the stickers but how they came to the idea that making stickers in that way helped to connect them to an interest visually.

Identifying How to Illustrate Interests. As with the CoD Group, the Expression Group was tasked with first determining what their pack of stickers would be themed around. The group rather quickly decided upon the utility of the stickers rather than a specific interest. As they described it, they wanted to stickers to help them show how they feel about something by putting a sticker on it.

14: Sabrina So, we're thinking about doing expressions.

15: Tammy Expressions.

16: Sabrina Yeah. So, like if someone is proud of it, you can like, put that sticker, like how you feel about it.

[...]

18: Naomi Memes, there's a lot of face memes that explains.

19: Sabrina The photos of that, we can draw with the stickers. We can draw it.

20: Tammy So, could you combine that somehow, like expression memes.

21: Naomi Yeah.

While this isn't directly connected to an interest, they did quickly start to explain a potential way it could connect to an interest. This connection was through the form of memes. Memes are often a visual medium by which people share details of their interests.

Stickers Illustrating People Connected to Interest. Memes were at first seen as being somewhat related to their interests. Members of the Expressions group proposed memes from media they likely had some interest in, such as The Kardashians. However, this is when some members of the group pushed back on including specific interests or concepts. The concern over the stickers depicting a specific meme was discussed in terms of how "easy" it would be to draw the sticker. However, the concern also seemed to reflect the complexity of the sticker conceptually as well. For instance, while drawing the Kardashians was seen as being too complicated the group went on to discuss including another meme, Pepe the Frog.

34: Sabrina Like, we could have the frog, Pepe. We could have Pepe.

35: Jasmine So, we'll draw Pepe.

- 36: Sabrina The Kardashian crying.
- 37: Jasmine You can't draw that. You have to draw easy stuff.
- 38: Sabrina Okay, Pepe.
- 39: Jasmine You need to think of things.
- 40: Sabrina Pepe.
- 41: Jasmine No, how does that relate to something? It has to be an expression.
- 42: Sabrina Yeah, well like, teeth.
- 43: Jasmine What?
- 44: Sabrina Teeth.
- 45: Jasmine How does teeth, like gossip?
- 46: Sabrina Yes.

The group then tried to grapple with how Pepe the Frog could connect to interest. A group member suggested that the teeth of the cartoon frog could connect to their goal of stickers being expressions. The frog having teeth would provide the ability to design a sticker that represents an expression. In a sense, the group looked at the complexity of the meme and tried to identify specific parts that could represent discrete emotions. This did not really happen with the Kardashian idea other than connecting it to the concept of crying in a general sense.

How Stickers Illustrate People Connecting to Interest. Identifying specific parts of stickers that could represent expressions was not the only concern of the group. They also had some desire to connect the stickers to the informal science learning setting Science Everywhere.

The design session was part of Science Everywhere, where they explored their everyday science interests. It is somewhat understandable that they would make a connection between the sticker reflecting their interests and the immediate interests around Science Everywhere.

At some point in the discussion, members of the group felt that the stickers must have a connection to Science Everywhere as a requirement. I did not personally direct them to make such a connection to Science Everywhere with the stickers. However, since they were often asked about their science learning interests as part of Science Everywhere in the past it is understandable that they might have made such a connection. In a sense, I was why they were “doing it” as one youth said.

The discussion about connecting the stickers to Science Everywhere was quite robust and took a fair amount of their design time. This discussion is when the group tried to focus on where and what the interests were that they were supposed to connect using stickers. They decided the interest was Science Everywhere.

49: Jasmine But it doesn't relate to Science Everywhere though.

50: Sabrina Does it have to?

51: Naomi Yeah, does it have to?

52: Jasmine It does.

53: Sabrina No, it doesn't.

54: Jasmine This is why we're doing it. She said it has to be related to Science Everywhere, because we're going to be using this on the thing.

[...]

- 71: Jasmine It doesn't relate to Science Everywhere.
- 72: Naomi I don't think it has to relate. They didn't say it had to relate. I didn't hear it.
- 73: Jasmine I heard LC telling the group, but how does this relate to Science Everywhere. I heard him say that.
- 74: Sabrina I didn't hear him say that.
- 75: Jasmine See, it has to relate to Science Everywhere. Everybody else is not going to do this. It's not going to make sense. All the other projects, none of theirs made sense except ours. So, ours also has to make sense too. What are you doing?

The concept of the stickers needing to “make sense” is important. This seems to reflect an understanding by the group that the stickers would be used as part of a sense-making process. It wasn't enough for the stickers to just be expressions, they had to also have some way for other people to understand the meaning of the sticker. Effectively, the group was discussing how to use stickers to turn Science Everywhere as an affinity space from a generator of their interest to being a portal for other people to understand that interest.

Discussion about How to Show Interest in Science. The group continued this discussion about how they could make the stickers reflect interest and the place of Science Everywhere. As part of the discussion, group members recalled past Science Everywhere experiences. When they discussed how another group was making stickers of food such as pizza, they connected the

pizza sticker to a previous Science Everywhere activity (“cooking chemistry”) where they made pizzas using different recipes.

86: Jasmine So, you can’t just do like random ones.

87: Tammy Random like what?

88: Jasmine It’s like you can’t just put like a, like a pizza. It won’t really make sense.

89: Naomi Okay, say if you were making a pizza, oh, look, I made pizza.

90: Jasmine You won’t even do that in Science Everywhere though.

91: Naomi Oh, cooking chemistry.

However, the group eventually decided against having something like a pizza sticker that would be an illustration of an object important to their interest.

96: Tammy You wanted a pizza?

97: Naomi No, I don’t want a pizza.

98: Sabrina It was just an example.

99: Tammy Oh, oh, oh, oh, I see, but you want something that’s really going to bring out the science.

100: Jasmine Because when he brings the photos, and we put the stickers, I want the stickers to, so the stickers could be used, like I don’t know how to explain it.

This is where the Expressions Group differentiates themselves from the CoD group. Still, the group wanted the stickers to reflect their interest in the science that happened at Science

Everywhere. As the facilitator pointed out they wanted to “bring out the science” that was being depicted in the photos they were going to design the stickers on top of.

Importance of Stickers Accurately Illustrating Emotion. Eventually, the group decided to focus on making stickers that reflected expressions rather than integrating the interests directly into the stickers. These expressions were primarily focused on how to illustrate an emotion or reaction such as face palming to show frustration. The Expressions Group designed their stickers to illustrate these expressions. Part of the design process involved them sharing and then commenting on each other’s stickers. While conversation mostly involved them commenting on how to draw the stickers, they did discuss what emotion they were trying to convey with the sticker they were designing.

249: Naomi This looks weird. I don’t like it. It doesn’t look frustrated. It’s a face palm.

250: Jasmine It’s so hard to draw a circle.

251: Sabrina I’m just going to draw it.

252: Naomi Face palm.

253: Jasmine I can’t draw a circle. This is so small. Bam, an egg.

254: Naomi I’m thinking. I’m trying to think.

255: Jasmine I’m doing like a curious face.

As they finished sticker designs, the group started to make the connection between the sticker and the photo they were designing the stickers on top of. In one specific case they described how they were frustrated at the time the photo was taken and why they were frustrated.

In a sense, the stickers were being used to reveal hidden emotional content of the image that could then be further explained by narrative during a discussion. The sticker didn't need to reflect their interest in the video-game Minecraft, it illustrated their feeling while playing Minecraft.

257: Naomi Yeah, we were frustrated.

258: Jasmine We were frustrated because we couldn't be on the same world in
Minecraft, and we kept on getting like ...

259: Naomi We couldn't connect.

260: Jasmine We couldn't connect.



Figure 8: Photo of youth playing Minecraft on iPads with reaction stickers placed next to themselves expressing emotions such as frustration due to server difficulties.

Inanimate Illustrations of Emotion. They also toyed with how to represent emotions or feelings without using a face. In this case they described how they could use a lightbulb to represent curiosity. The lightbulb was put in proximity to the head of someone depicted in the photo.

284: Jasmine Does this person look curious? Is this like a curious face? This person looks more curious than the one I did here. I actually like this one.

285: Naomi So, this one is better? Okay.

286: Sabrina I like the light bulb.

287: Jasmine That's too lame. Okay.

288: Sabrina I want my light bulb.



Figure 9: A lightbulb sticker is placed over the head of a youth in a photo of a lecture about watersheds to represent having an idea and an interested face to represent interest.

The Expressions Group created and used the stickers essentially to directly illustrate emotion. These emotions were connected to the people in the photos from Science Everywhere. The emotions also usually detailed some hidden information that was not easily readable from the photo alone (e.g., being frustrated while playing Minecraft). While the stickers did not represent aspects of an interest itself, they were connected to the interests that were represented as part of the photos from Science Everywhere. The stickers were connected to the interest by their placement on the photos. The goal of the group was to create stickers that could help to

explain details of those interests. Making stickers to reveal this personal information is just as important to communicating about the interest of an affinity space as illustrating the interest itself. Understanding why the individual youths enjoy or connect with an interest is important as the next section will detail when looking at four focal youths.

Focal Youth Interests. Now that I've provided two examples of group activities to help show how they communicated and explored personal interests I will look at a select group of four focal or exemplar youth to illustrate the personal side of the interests, as well as how stickers could be used in the context of a physical informal learning setting. Interviews with focal learners show how the youth think about their interests and touch on elements such as how they engage with the interest and how they share the interest (if at all) as part of a program like Science Everywhere.

This discussion about interest is through the lens of technology to share or socialize with or about the interest. This is important to determine because how the youths share details of their specific interests could impact their usage of stickers for sharing details of those interests. With that in mind I will provide examples of these youths explaining how and why they engage with their interests that could impact future usage of stickers to communicate or explore their interests.

The four focal youths here illustrate four different youth goals or motives for sharing interest. I will provide examples of how the youth discussed a more place-based interest, interests where social interaction was more key, a mixture of the two, and finally a focal youth who used a mix of social and place but had reasoning for keeping some interests more personal and others more social.

Stickers Augmenting Place: Enrique. Enrique was a member of the CoD Group who made stickers that represented objects from Call of Duty. These stickers were then used on top of photos from Science Everywhere to create CoD scenarios inside of Science Everywhere. During an interview Enrique revealed a difference between how he designed stickers to explore his interest as part of the CoD Group and how he talked about interests.

In the interviews, rather than talking about a media-based interest, Enrique now talked about an interest in vocation. He wanted to get a job in tech and he talked about how he not only would share his interest through working at a job but gave a specific example of working at Microsoft. Arguably this interest was a more place-based due to how he framed sharing his interest as being part of a second place (e.g., working at Microsoft) rather than being about a piece of media (e.g., socializing about the game CoD).

Novelty is Important to Interest. When initially asked, Enrique described his interest in terms of novelty. Novelty, of course, isn't a specific interest but rather a parameter for how he chooses what is interesting. This parameter is important, as it helps to explain important parts of interests.

4: Enrique I'm interested in finding out something new and not having the same answer every time.

5: Daniel So, you like new things. Is that all about the same thing, or does it have to be about something specifically?

6: Enrique Like if you have one thing, and you find out the answer, then I would like to move onto something else.

Specifically, Enrique connected novelty to finding new answers. It is implied that asking different questions with the same answer would be unappealing to him compared to something that would result in a new answer.

Sharing Interests and Organizations. When asked for specific details about his interest, Enrique continued to broaden his description of the interests. As Enrique detailed his interest in learning new things, he narrowed down his interest using an example profession. Enrique linked his desire to learn new things with potentially working for Microsoft.

13: Daniel So, right now you're interested in technology. Any specific parts of technology or specific technology?

14: Enrique Robots, cellphones, stuff like that.

15: Daniel Okay, so like, really high-tech stuff. Okay. So, do you know anyone or a group that might share this interest that you have?

16: Enrique Microsoft.

17: Daniel Okay, so like a company. Okay. How would you communicate with, for instance, Microsoft?

18: Enrique I would write an essay talking about how I'm interested in doing this and that and learning new things from them, and having a great experience, and seeing how it goes with them.

Enrique framed sharing his interest with the company, Microsoft. Once he framed sharing as being job-related, Enrique was able to give more specifics about his interest in novelty overall. Enrique even began to roughly describe how he would apply for a job at Microsoft.

21: Daniel Okay. How would you share this with some other group that might share this interest?

22: Enrique If it's someone making a new phone or a new technology or something, I would be trying to be a part of it and help as much as possible. Like, help add new features and stuff like that

When prompted for more specifics about how he would share this technology interest he kept the topic to the idea of a job search at Microsoft. He roughly described how he would like to share his interest by helping to add new features to technology while working at Microsoft. Overall, he was very focused on how he could explore his interest of creating new technology and finding new answers at a place of work, specifically Microsoft. The place of Microsoft seemed to be a key part of Enrique's interest.

Place Needs to be Connected to Interest. When asked about this focus on place, Enrique gave information related to a visit to a learning center as part of a school event/activity. He explained how during this group visit he learned how to "be an adult". It is also implied this location might have been where some of the details about how to apply to a job at Microsoft came from. However, while this place was important for providing him with the idea that applying for a job at Microsoft was important, the place itself seemed to be somewhat uninteresting to him. Enrique could not recall many details about the visit, including the name.

28: Enrique I don't know what it was called, but the whole school went. A lot of schools went there to see how it feels to be an adult and pay bills. At the end of that they gave us a debit card, and we had to go to different machines and pay the bills on the right time and stuff like that.

[...]

47: Daniel Okay. How would you share what you learned when you went to that place?

48: Enrique I learned that it's really hard to be an adult paying all these bills and paying on time.

49: Daniel So, how would you share that though?

50: Enrique I don't really know how to share it.

Interestingly, when asked how he would share this information, which he roughly did just moments before in the conversation, Enrique claimed he did not know how to share this information. This points out that while that he has concepts of the interest and the places they are connected to, he does not feel comfortable or does not know how to talk about the details on some level.

Overall, Enrique was focused on finding new answers. He felt his drive to find new answers could contribute to a job or workplace. While places where he learned important things (e.g., how to apply for a job) were important to him, it was only important because of its ability to help him find those new answers.

Stickers Facilitating Social: Marcos. Marcos was another member of the CoD Group. Overall, Marcos seemed to care more about the social play aspect of his interests than the specific interest topic itself. The social component of interest is important to disposition. Social is also a vital component of interest associated with Affinity Spaces.

Unfortunately, Marcos's interview data is somewhat limited. Marcos left the study in a sense because of how important social interaction was to his everyday interests. Marcos's friend, Enrique no longer had enough time to time to participate in Science Everywhere, which resulted in Marcos also reducing his participation in Science Everywhere (and by extension the Sticker research).

Interests are "Cool". When asked, Marcos provided a definition of interests as something that is "cool". There was an implication that what is cool can change by him referencing it needs to be cool "today". But, overall, the definition was a bit self-referential. Interesting things are cool.

6: Marcos I would say like something cool, something fun or cool today, and I would find it interesting.

[...]

18: Marcos So first we had to start with you know how there's buildings, and you started with trash, because the trash harms the environment. So, then you build buildings. Then we started with trash around the area and through water and see how the water pushed down to the, I think storm, something like that.

When asked to go into detail about a specific interesting or cool thing, Marcos picked something from Science Everywhere. He picked the design session where they created a model to show how to clean trash or other pollution from rainwater runoff. It should be noted that this was the session depicted in the photos which they designed the sticker to be placed on top of. He

went into some detail about the activity but didn't really describe exactly what was cool other than the building part.

Sharing Interests with Friends is Memorable. When asked how he shares his interests, Marcos roughly described how he would want to bring people and do the interesting activity with them. He then provided an example based on Science Everywhere that involved building something and then sharing that design to recruit people into the activity. This is interesting because while Science Everywhere the place was important to the activity, Marcos was more focused on the activity of building as the main source of the interest to share. Unlike Enrique, he didn't really discuss the place in much detail. The place was the location of the activity, but it wasn't as important as the activity itself.

25: Daniel So, if you did know a group or some other people who are interested in it, how would you like share what you did with them?

26: Marcos I would share it, I mean if we were here, I would show it to them how I build it and how was it built, and we'd be a great team.

27: Daniel So, you'd try to like recruit them.

28: Marcos Yeah.

This focus on an activity for an interest continued when I asked Marcos to specifically talk about place. Rather than give details about what he liked about a place, in this instance a church, or how it was important, he instead talked about the thing he learned or the people that were there.

32: Marcos I would say church, because we're here really to read, right? I mean you learn about other things [...] I learn things, myself, I learn things, how to pronounce the phrases they say and as well here.

[...]

37: Daniel Who are at these places, like friends, family?

38: Marcos Family.

[...]

41: Daniel Okay. So, what's an example of something that you have or maybe you'd like to share from one of these places with someone else but you haven't shared that?

42: Marcos Probably to my friends the things I did here or created. My creations or, remember that roller coaster?

The place itself wasn't as much of an integral part of the interest beyond it being where he happened to be – Marcos gave no specific details of how the church itself would facilitate his interest. Rather, Marcos talked about the people who were there with him and who they were. Marcos emphasized sharing specific details of his interest more than explaining how the place itself facilitated his sharing.

Overall, social was very important to Marcos. He had a desire to share things he created and at times wanted to recruit people to help him build more things. The place or space wasn't as important as the ability for him to share those things that he built. The act of creation around the interest seemed to be paramount.

Place-Based Media Interests: Jasmine. Jasmine, and her sister Sabrina, talked about watching television. Importantly it was about watching a specific reality television show with specific family (mainly her sister but also some extended family members of a similar age to her). There were components of both place-based (i.e., home) and affinity space (i.e., the reality television show). The reality television show was the more focused of the aspects of the interest but the technology to watch the show was very place-based, as it was implied as being only at home. There was some place-based discussion of Science Everywhere as an interest, but they didn't seem to want to go into extensive detail when talking about it with me.

Learning Interests Exist in Places. There was a wide range of personal interests ranging from more academic to more for entertainment. The youth often started with learning interests when asked to share something they found interesting. For instance, when asked about something that interested her, Jasmine referenced the astronomy activities we did as part of Science Everywhere. It is of interest that she compares the Science Everywhere activity to school, but it isn't explained why this comparison is made.

7: Daniel So, what's something interesting that you've learned about?

8: Jasmine Here at Science Everywhere?

9: Daniel Anywhere.

10: Jasmine I think the space stuff that we're doing right now, because I'll be asking [...] questions about like the earth, because we don't learn that kind of stuff at school.

When asked how she would share her knowledge with people, including those at school, she did not appear to be certain. She did give a specific example of “meteors that happened” but it was not explained how that information would be conveyed nor what meteors she would talk about.

18: Jasmine I guess we ask questions. If we were like searching up meteors that happened, so we just like share information.

A few months later when Jasmine was interviewed again as part of the more extended study she did talk about Science Everywhere again. As with the astronomy interest, she told me how she was interested in the rain garden activity that she recently was a part of.

4: Jasmine Here or anywhere?

5: Daniel Anywhere.

6: Jasmine I guess the purpose of a rain garden and yeah, basically yeah, why they’re used and stuff.

In this rain garden activity, Jasmine and other youths were tasked with designing a sign to explain a rain garden to some friends. She roughly explained what she was doing but it wasn’t detailed (i.e., “stuff”). An interesting note is how she clarified that the interest was related to the specifics of how and where to build the rain garden (i.e., “why they’re used and stuff”). The social aspect of designing and building the rain garden was not brought up but rather the details of how the rain garden worked in the place was important.

Learning Interests Involve Social Experiences. Similar to Marcos, Jasmine expresses the importance of social experiences for these placed-based learning interests. For instance, Jasmine provided an example of an interesting thing she learned at school.

9: Daniel So, political science, you're interested in. Okay. So, what about you Jasmine? It doesn't have to be at school. It can be anywhere.

10: Jasmine Yeah, I mean, at school we were just talking with my friends about like animals and stuff, and we like got on the subject about otters. Then, I didn't really know a lot about otters. So, we were just talking, and I learned how they like lived in their environment, stuff like that, which was interesting.

Jasmine's explanation of her learning about animals at school involves her friends. She quickly transitioned from the school lesson to instead explaining how her group of friends shared the interest such as how the group learned about where otters lived.

Media-based Interests at Home. While Jasmine initially was focused on describing an interest located in a place, she did have interests that were media based as well. I asked Jasmine what she found interesting that she didn't believe her parents believed involved learning. At which point, Jasmine brought up a reality tv show that she likes. Essentially, Jasmine shifted from talking about places to media the moment she was asked to talk about non-traditional learning. When asked for details about her interest in the particular TV show, she roughly describes the premise (survival) and why she enjoys it (able to determine the correct decision for the people in the show).

- 12: Jasmine Okay. So, I watch this TV show, and I feel like I learn stuff from it, but my parents call it stupid, but I watch it.
- 13: Daniel So, is it like an animated show?
- 14: Jasmine No, it's with real people.
- 15: Daniel Okay, so you learn from this TV show.
- 16: Jasmine So, it's called Naked and Afraid. I just learn how they survive and stuff. I don't know how to explain it, just over the course of the days, since I've watched it for a really long time, I know like what they're doing that's wrong and what they should be doing.

After Jasmine explained how she does not believe her parents think she is learning from the show I asked her if she shares the show with anyone else. Jasmine explained that she does watch it with her sister. They watch the show and predict what they think will happen next based upon their previous knowledge of the show.

- 23: Daniel Okay. So, do you know anyone else who is interested in this TV show?
- 24: Jasmine My sister.
- 25: Daniel You sister. How do you talk with your sister about it?
- 26: Jasmine We watch together.
- 27: Daniel So mostly you just talk about it when you're watching.
- 28: Jasmine Yeah.

29: Daniel Yeah, just like a TV watching thing, okay. Do you ever talk about it at other times or just when you're watching?

30: Jasmine Yeah, sometimes.

31: Daniel Is there any time in particular?

32: Jasmine Like if a new episode is coming up, and we're like talking about what might happen.

33: Daniel So, you make predictions?

34: Jasmine Yeah.

While it isn't unusual for people to watch and discuss a show together it is important to understand the constraints round the social aspects of sharing this interest in the show. Jasmine's explanation of how she watched the show with her sister indicates that they watch the show at home during its scheduled time and that they talk during it. The discussion about the show seems to be constrained by both where and when. For instance, the discussion mostly happened close to the airing date of the show and usually at home. In this way, the place and time components of the show seem to be important.

When I asked the two sisters together about their shared interest, they expanded upon how they socialize about the tv show. Not only would Jasmine and Sabrina watch the tv show with each other they'd also watch it with their cousins when they were at their house. They also talked a bit more about how they were interested in the challenge of surviving for "21 days".

15: Daniel Okay. So, what is something sort of interesting to you that your parents may not think involves learning?

- 16: Sabrina TV shows.
- 17: Jasmine I was going to say that.
- 18: Daniel TV shows. What kind of TV shows?
- 19: Sabrina Like reality ones about drama and stuff.
- 20: Daniel Okay. Yeah, I think I remember you talking about some of those during the summer. Which one was that during the summer again, or maybe it's a new one you have now that you're really interested in?
- 21: Jasmine It's Naked and Afraid. It's like a survival show, but they don't like me watching it, but I think it's interesting like how they have to survive off of nothing for 21 days.
- 22: Daniel Cool. So, do you know anyone else who shares this or is part of the group who shares this interest in this TV show?
- 23: Jasmine Yeah, our cousins. We watch it with our cousins.
- 24: Daniel Watch it with your cousins. So, do you like local with your cousins?
- 25: Jasmine When they come to visit, we like watch shows together.
- 26: Daniel Okay. So, you just communicate with them, like they come over, and you all watch it in the same room with the same TV?
- 27: Jasmine Mm-hm.

The social interaction was heavily implied to be mostly (if not only) around them watching the television show together locally. It is interesting that while they seem to be very

interested in the show and the subject, they didn't talk about discussing the show outside of while they were watching it. In a sense, the media-based interest is contained in the place of watching the show in their home.

Connecting Place, Interests, and Social. Picking up on a theme of place being important when socializing about interests, I explored this further. I asked Jasmine to be more specific about a place-based interest and what she remembers doing in the places. Before she had talked about the astronomy and then the rain-garden units as part of Science Everywhere. When she was asked about remembering specifics, Jasmine talked about the coding unit and connected this interest between Science Everywhere and school.

28: Daniel Okay. So, shifting over and more talking about sort of places. Thinking specifically sort of about Science Everywhere as a place, what were the different things you remember learning at Science Everywhere?

29: Sabrina About coding.

30: Jasmine Yeah, I learned a lot about coding too, because that's what we were also doing at school. So, I was able to like implement what I learned at school to what we were doing here at Science Everywhere, because we were using like the same things, like websites and stuff that we used at school.

When asked about if she also shared the interest about coding, she explained that she told her school friends what she did during Science Everywhere. Additionally, her friends also asked her on their own about Science Everywhere because they knew about her attendance in the

program (she had been attending for several years at this time). This connection was facilitated to some degree by having a science teacher at her school who was also involved in the Science Everywhere program as part of a partnership.

32: Jasmine I talked about it with my friends sometimes, because they'd ask me like, why do you go there every Thursday, and I'd like, tell them what I did. Then at [our middle school], there was this one teacher that was kind of involved with Science Everywhere. Like, he kind of knew about Science Everywhere. So, he would like, ask me what we did and stuff, and I'd tell him.

Later, I changed the wording of questions from about "interest" to about "cool" to see if there would be a difference in communicating activities around Science Everywhere. I did this because interest and cool seemed to be somewhat interchangeable as descriptions when talking to them about things they enjoyed.

38: Jasmine [...] I remember making plans with Naomi to go to the symposium. Then we started talking about the symposium, and we were talking about it with our friends. We had to tell them like how we had to present in front of people and just explain everything we did, yeah.

39: Daniel Were you one of the ones that were part of like the sort of like thing where you had to sit up in front of a bunch of people, or were you just talking about the poster session?

40: Jasmine Just the poster.

41: Daniel Just the poster session, okay.

42: Sabrina I don't think I've ever really done anything like that.

Jasmine brought up the experience where she, Sabrina and some of her friends created a poster and shared it at the UMD HCIL Symposium. She picked this interest because it was something she had never done before. This seems to imply that novelty and social experiences do play a factor in these interests that she enjoys.

Overall, Jasmine's interest could be described as a mixture of media-based and place-based. Jasmine could explain interests from places like school, but she also had media-based interests about a television show that she felt involved learning. Importantly, this media-based interest wasn't devoid of a specific place. Experiencing and sharing the interest in the tv show happened primarily at home. Jasmine expressed her interests in a variety of ways.

None Of the Above: Isabel. Isabel was an interesting mix of analog only (e.g., the Poetry club) and using technology (e.g., researching vacation). This mix included social (with her mom) and no social (Poetry Club). Examples of her interests were fairly place-based, though. Ability to use "insert technology" (stickers or not) were more linked with social interests than non-social. She even used stickers to play a prank (which is a pseudo interest). The main point is that she seems to keep the learning places and the affinity spaces separate. She maintains fairly strict social groups around these different places and spaces as well.

Creating is Sometimes Important to Interests. Interests weren't just about consuming media or socializing at a place. Similar to Marcos's description of interests, the act of creating something is often important to an interest.

- 8: Isabel Making videos and like editing them.
- 9: Daniel Videos and editing. What's sort of like something you sort of learned about videos and editing.
- 10: Isabel Things can be cut out.
- 11: Daniel So, you learned about the general editing techniques. Do you know like groups that share this interest?
- 12: Isabel I mean there's some sites where you can like talk to people about how to make your editing better, but I don't really join those.

When asked about her interests, Isabel talked about how she enjoyed editing videos. She also detailed how she learned how to edit videos online with people. She also explicitly mentioned that she didn't join groups that would involve working with other people about her internet use in video editing.

A Specific Place Isn't Necessary. I then asked Isabel about any places she might go that involved an interest. She initially stated that she didn't know any place but then settled on how she does go to the school library. When asked if she shares things from the library, she didn't seem to share anything directly from the library. Instead, she implied that she went to the library as part of a project. Once the project was completed, she may then share the details. The projects were likely school projects since she was talking about the school library. Isabel didn't really go into detail about a specific interest being important, instead it was about when it was "time to do something" rather than necessarily where she was.

29: Daniel You go to the library, like a school library? Okay. So how would you share something you did in the library, like you learned about in the library with your friends and family? How would you share that?

30: Isabel I could tell them, like show them what I did. Like if took most of the time to do something, and I'm at home when I did it, then I could show them.

The interest being topical to the moment is important. This is especially true when sharing something that is interests. For instance, Isabel described how she shared a photo of a blackhole with her friend via instagram.

29: Daniel Do you have an example of something that was really cool?

30: Isabel One of my friends shared a post and was talking about the black hole.

31: Daniel Oh, okay.

32: Isabel It had a picture of it. Yeah, we were like, talking about that.

33: Daniel So, was that one of the recent sort of like astronomy type news stories, you were talking about that?

34: Isabel Yeah.

35: Daniel Cool. So, you were sharing that on social media. Was that like a chat service?

36: Isabel It was through Instagram.

The recentness of the blackhole picture is what was important rather than where she was. This is similar to Jasmine and her sister discussing a recent tv show. However, unlike Jasmine, Isabel didn't do this conversation at home. Isabel didn't even explain that the astronomy story was on Instagram until she was asked, implying that the space or place was not as important as when she and her friends discuss items of interest.

Understanding When or Where Interests are Shared Online. Since place wasn't necessarily as important for Isabel, I explored if there was some other way than place to define what was important to her interests. When asked about online spaces that were important, Isabel described how she used Snapchat and talked about how she used it both with text and images. The images she shares on these platforms are mostly memes. The content of the memes didn't seem to relate to any specific interest other than the requirement that the memes be funny to her and likely her friends that she talked with. However, while she talked about how she shared memes with her friends, she did not use Snapchat to share with her parents.

52: Isabel Yeah, like we send each other like pictures, like memes.

53: Daniel Yeah. So, what do you think when they share a lot of those images?

54: Isabel I laugh at them.

55: Daniel You laugh at them. They're funny?

56: Isabel Yeah.

57: Daniel You didn't say your parents. So, you don't talk to your parents on
Snapchat, right?

58: Isabel No.

A few months later during the next interview she answered the question about something interesting that she learned somewhat differently. Technology and friend groups were still involved but now she was including information about stickers as well as more detail about the inside jokes she has with her friends.

6: Isabel I learned that getting sleep is good. I learned that like the stickers that we use, we use it more often than we think that we do. Like for me, I use it a lot with my friends. Like without thinking about it, I just use them. If I think something is funny, then I'll use like a sticker pack to say it's funny.

7: Daniel Okay. So what kind of things do you find are funny?

8: Isabel Like inside jokes.

9: Daniel So are these like ... what are the kinds of things you do with your friends? Are they like sports, or do you ...?

10: Isabel So, it just depends. I have certain friend groups. One is for my sports like softball. Then another is just like we both went to the same school or like Naomi. We went to the same school, but now we're like not in the same school. We still talk to each other. Yeah, we just talk to each other a lot. Then I have like my school friends that sometimes I talk to outside of school.

11: Daniel Okay. A lot of your interests were based upon your different friend groups?

- 12: Isabel Yeah.
- 13: Daniel Then how do you communicate with these people? Obviously, like they're not all at school as you said. Naomi is not in school anymore. So what kind of different ways do you communicate with these people?
- 14: Isabel I text them most of the time, because they don't ever like call or something. Like if it's something really important I'll Facetime them, but it's usually just like texting or like do our apps like Instagram and Snapchat.
- 15: Daniel So, is like Instagram and Snapchat and like messages like your sort of go to communication apps?
- 16: Isabel Yeah. If I want to send one of my friends something that's funny in Instagram, then I'll send it through there. Then like we'll start a conversation through there.
- 17: Daniel So, it's wherever the media is.
- 18: Isabel Yeah.

When asked for more detail about how she talks with her friends, especially since they're not always face-to-face, Isabel then explained that she socializes with the friends essentially where the interest or topic is. This means she could use Instagram, Snapchat, FaceTime, or any other technology that is conducive to what the group is sharing. One thing that was specific though was how Isabel talked with her mother compared with how she socialized with her friends.

- 25: Daniel Talking with your parents, what are the kind of things you're talking about with your mom for instance, in general?
- 26: Isabel With my mom I usually talk to her about making plans and stuff like that. So, I don't really use stickers or anything like that. Sometimes I like say a joke to her, but that's it.
- 27: Daniel So, is it like the joke is written out in text?
- 28: Isabel Yeah like, no like sometimes if we're in the same place, and I want to tell her something, like oh, did you see what she's wearing, or something like that, then I'll text it to her so that nobody else can hear us.
- 29: Daniel Oh, okay. Okay. Do you ever share like images or anything with your mom?
- 30: Isabel No, not really. Not like images, no.

While Isabel had examples of several different platforms where she shared her interests with her friends, sharing with her parents was limited to a seemingly a single online space. Instead of using a variety of technologies to share an interest she described how she only text messaged her mom and did not use images.

Sometimes Just the Place is Interesting. An interesting detail regarding place is that the place itself might be the interest. Unlike previous examples where the interest existed in a place or was potentially dependent on something that happens in a place, the place itself might be the interest itself. When I asked Isabel a bit more about her formal learning interests she went into a fair amount of detail about a trip to the University of Maryland.

- 41: Daniel Okay. Rewinding a bit, talking about play space learning. What is an interesting place that you've sort of been to recently?
- 42: Isabel Recently I haven't really gone anywhere. I've just been to like University of Maryland. So, like I've just explored the University of Maryland for six weeks. Like the school and classes and stuff. So, there was nothing like for me to explore too much, but yeah.
- 43: Daniel So, this was part of that program.
- 44: Isabel Yeah.
- 45: Daniel What was sort of like the thing that you thought was the coolest thing you learned, not necessarily from the program? It could also just be from your wondering around University of Maryland. So, what was kind of like the coolest thing?
- 46: Isabel There's nothing really cool about it. I just like saw everything. There's so much like greenery, and then like there's so many animals just roaming around like squirrels and birds. So, we would look at those sometimes. We would just stop if we had extra time. Then kind of like how far the walks are. So, we would look at some of the buildings. I would go through the [...] building, which was cool because they had like the statue. Like everybody would like go near it. Then like the turtle in front of ...
- 47: Daniel Yeah.

48: Isabel ... the library. Yeah, everybody would go there. So, we would sometimes like stop and like see how people reacted to the turtle, because everybody is always taking pictures near it.

It is important to note that Isabel thoroughly described her time at the local university. Specifically, Isabel described the university as a place rather than the program. As she put it, “there’s nothing really cool about [the program].” Essentially, her interest was the place rather than the program that was happening in it. This is an interesting wrinkle in how sometimes the content of a place may not be what is interesting, it could just be the place itself.

Social Is Supposed to be Fun. During the last interview with Isabel, I opened by asking her to talk about a very recent interesting thing she learned. Instead of a specific thing she talked about the poetry club she was a part of. She was a bit reluctant to give much detail about the club. She eventually talked about how she liked that poetry allowed for multiple interpretations of meaning. When asked about who she might discuss poetry with to get a better understanding of the people who might be interpreting poetry with her she limited it down to just the people in the club and face-to-face only. She didn’t seem to want to expand the group any farther than that.

15: Daniel Okay. So, why would you say you’re interested in poetry?

16: Isabel I don’t really know. Because like, every poet has a different meaning to what they’re talking about. Like, somebody could interpret it a different way. I just find that cool.

17: Daniel Do you have any conversations about the different meanings with anyone?

18: Isabel In class we have discussions.

19: Daniel So, you have in class discussions, but you don't really do it outside of class?

20: Isabel Sometimes. It just depends.

21: Daniel It really depends?

22: Isabel Yeah.

23: Daniel So, is this like a face to face sort of things in school?

24: Isabel Yeah.

And another group she had was the softball group. Again, she kept the softball group chat contained to just that group.

44: Isabel It's usually like what we're going. Some girls on my team just talk about whatever they want. If they want to vent, then they'll just vent to the group chat.

45: Daniel So, it's about anything, not necessarily about softball.

46: Isabel Yeah.

47: Daniel But sometimes ... you know each other through softball, or did you know each other before softball?

48: Isabel No, we knew each other through softball.

This description of the softball group continues Isabel's pattern where her interest is not necessarily the immediate content or activity. The interest could be as simple as enjoying the

people she is with. This is similar to how she enjoyed being at the university but didn't express any interest in the activity that was the direct reason for her being in the place. It is important to be able to distinguish what the interest or the motive is and not immediately assume the interest is one piece of content or another. Understanding what the interest is can in some cases be distilled down to essentially the concept of fun. One interesting example that involved stickers as part of a social interaction was when Isabel pranked her friend with stickers.

139: Daniel Yeah, so what was maybe the coolest use of stickers by her?

140: Isabel Me and my friend, we like, pranked my other friend, because she didn't know stickers could go onto the text. So, like we just put a bunch of Russian stuff on it, like Russian stickers on a text. She would just be like, oh my gosh, what is on all my stuff?

141: Daniel Oh, so she didn't know how stickers worked in iMessage, and so you were sort of like messing around with her?

142: Isabel Yeah.

Isabel's description of how she and another friend used stickers is an exploration of fun. The stickers were used as a prank to essentially edit another friend's comments in iMessage to make it look like that friend was speaking Russian. In this case goal of the stickers wasn't an interest but was instead to have fun. While not strictly speaking an interest, this is an important consideration for using stickers. They need to be fun regardless of if they can be involved with learning in a social context.

Overall, Isabel could be described as very discrete. Isabel talked about many interests. These interests either had very defined ways she would share or communicate them or no communication at all (e.g., Poetry Club). That isn't to say Isabel does not enjoy socializing. She did describe her interests as part of the interviews and did engage with interests as part of the *Sticker Pack Design Session* which involved social interaction. Her expressed desire about when she does communicate her interests is limited to specific contexts, though. In a sense, Isabel does not connect interests with others as openly as the other youth, Enrique, Marcos, and Jasmine. Introduction of stickers to facilitate communication will need to include a recognition that not all youth will necessarily have the same desire to use stickers as a way to socialize about their interests.

Summary of Focal Youth. These focal youths roughly describe their interests in terms of 1) Stickers Augmenting Place, 2) Stickers Facilitating Social Interactions, 3) Place-Based Media Interests, and for lack of a better term, 4) None of the Above. These categories will be explored in more detail in the discussion where I will connect the interviews to the *Sticker Pack Design Session*. How the focal youths expressed their interests will be compared to how they worked with their groups when designing stickers, including an exploration of which kind of sticker, the media interest style CoD stickers or the place detailing Expressions stickers, might work better for their stated interests.

Of course, this is not an all-encompassing description of the possible spaces for stickers being used to communicate interests but rather is focused on how these youths communicated their everyday interests in an informal science learning setting. Connecting how the youths

created stickers for communicating interest to their stated everyday learning interests will help to identify aspects of stickers for further exploration as part of RQ2.

Discussion

In the discussion I will connect the examples of how groups of youth created stickers, how individual exemplar youths discussed their personal interests and, how they shared those interests. It is important to note that the interest-based stickers were created by a group and interests were discussed on an individual level. The goal of understanding how stickers can be used to communicate or illustrate interests requires that the stickers be used with multiple people. While the youth all have their own particular and specific interests, they do share some commonalities. The CoD group is a good example of this, where all three youth were interested in the game Call of Duty. But they all had their own unique favorite game and reason why it was their favorite. It is important to understand how stickers are used at this intersection of personal interests and group interest. This intersection is then useful to understand when looking at how stickers are used to communicate not only with people who share an interest but with those who may not share it or even be aware of the content of the interest.

To do this I will establish a lens using the group sticker creation from the Findings. In the Findings I provided examples of the CoD and Expressions Group that showed two different types of stickers for communicating youth interest. The CoD Group stickers directly referenced parts of the interest by representing them as stickers (e.g., guns and zombies). The Expression Group stickers still connected to the interest, but they did so by using the stickers to further explain depictions of the interest rather than directly referencing the interest. These two different

interpretations of how stickers should connect to interest by the youth shared some commonalities.

I will go into the two lenses from the co-creation of stickers. These lenses are (1) stickers should help illustrate the youth's emotional interest or passion behind the interest and (2) there is a difference between how stickers can communicate interests depending on the audiences' familiarity with the subject (i.e., an in vs out group). After going into these two lenses, I will then explain how individual, exemplar youth discussed their real, everyday interests as part of the interviews. I will then speculate as to which type of sticker pack could potentially be useful to help the youth either express why they are passionate about an interest or help them better express an idea with an in or out group.

Stickers for Interest. The focus for this section is to explain how the CoD Group and Expressions Group stickers connected the youth to their interests. This section will specifically look at how youth envision stickers representing their group's interest. I will in detail add to current understanding of how the design of visual media can communicate important emotional information about interests. For instance, the design of characters in games, including features such as shape and color, can impact learning interests via a learner's emotions (Plass et al., 2020).

I will further detail specifically how stickers can potentially impact the communication of interests via aspects such as emotional connection, but also the importance the design of spaces for sharing. These details come from both sticker pack groups. The data from these groups point to design implications for how stickers could help youth communicate abstract ideas that might otherwise be difficult for them to express. In particular, the design and usage of stickers were

modeled after concepts such as Mixing Ideas, that assists with collaborations between youths and mentor or teacher figures (Guha et al., 2004). This collaborative goal is important as conveying youth's passion about an interest can sometimes be difficult for an audience who may not be familiar with all the details. This discussion will point out important points for how stickers might help youth to communicate their interests on their terms.

Stickers and Emotion. In this section I will explore how stickers can be used to explore the emotions behind an interest. Understanding these emotions is important because it can help point to specific reasons why a youth is engaged with an interest. This kind of interest-driven engagement is the focus of the theory, Affinity Spaces. An affinity space is, on some level, is a shared social space where people can engage with and communicate about an interest (Gee, 2005). Using symbols with socially constructed meaning rather than just written or spoken words fits within the definition of an affinity space. Unfortunately, most research is focused on the written or spoken word for communication in the context of informal or everyday learning. There is some research on image-based communication such as emoji. For instance, emoji have been demonstrated as assisting people to communicate sentiments non-verbally (Alshenqeeti, 2016).

Another relatively new and common way for people to express ideas visually online are Memes (Dawkins, 2016). While there is some discussion about the impact and utility of memes from an academic perspective (Hinchman & Chandler-Olcott, 2018), the common, layman usage of the term describes a kind of image with overlayed text ("Gameplay Mechanics: Specialists.", 2023). It is important to note there are differences between emoji and memes (and stickers). For instance, memes tend to communicate more information rich ideas. This isn't without flaws. For

instance, memes can sometimes come into conflict with effective messaging of ideas by assisting in the spread of misinformation (Isaacs, 2020). This example of memes spreading misinformation points out how it is important to understand how people do and could communicate with stickers to avoid potential negative information outcomes. It is important to understand how stickers can appeal to the emotions of youth in a productive way while exploring ideas such as a scientific learning goal.

One way that can assist is by looking at communities that already heavily feature passionate exploration of interest, such as the previously mentioned Affinity Spaces. Affinity Spaces differs from a more common scientific Community of Practice because it designs the space around the interest rather than a particular practice. I mention these two theories of Affinity Spaces and Communities of Practice not to compare and contrast them but rather to give an example of how two different lenses of communities and sharing use images while communicating. This difference is important for understanding how stickers could be used in the context of an informal learning environment for communicating youth interest.

The data from the *Sticker Pack Design Session* points to stickers as a potential way to help youth communicate the emotions (i.e., their passion) behind an interest. This interest could be science based in the case of the Expressions Group. In this case, stickers are images that represent complex ideas using metaphors and essentially “physical” connections of ideas by placing the sticker on something else. We saw the Expressions Group state their emotion while using the stickers of faces smiling, frowning, or making some other expression in association with an image of an activity. They provided information that was otherwise difficult to discern about how the youth felt while doing the activity. For instance, one might assume the youth were

happy while playing Minecraft. Instead, the sticker showed that they were frustrated. This provided the facilitators with an opportunity to ask why they were frustrated. Without this information about their emotional state, the facilitator might not have asked and thus never learned about what the youth felt.

While the CoD Group stickers were not as directly linked to the emotions of the youth who made them it still had information about their passion. The CoD Group made stickers that reflected their interest in the CoD videogame. The specific stickers they created were picked for personal reasons and thus have some information about the interest. For instance, the youth explained several times that they picked a particular thing to make into a sticker because they “liked” it. This then resulted in some discussion where they explained why they liked something. While this isn’t as direct an expression as a smiley face, details like a gold-colored gun can provide insight into things such as the feeling of pride, for instance.

Both the Expressions and the CoD Group stickers can help provide insight into the emotion connecting a youth to their interest. This connection between youth and interest can then be further explored to better understand the passion behind the interest and potential ways to help the youth connect to the interest. Ultimately, stickers could help to provide this kind of ambient emotional information that is needed to understand interest.

Sharing New Interests with Stickers. Affinity spaces often create their own terms or jargon to communicate specific ideas. Gaming affinity spaces do this quite often to communicate complicated concepts quickly (Gee & Hayes, 2012). For instance, the CoD Group from my research talked to each other while using jargon when designing and communicating using their stickers. While the written or spoken jargon is relatively well understood, it is not as clear where

something like stickers would fit in to this kind of communication between people in an affinity space. It is important to understand how stickers can be used to communicate not only with people who are familiar with the interest but also with people who might not know about the interest or consider the interest to be new.

The concept of Generators and Portals is important when considering how stickers might communicate. Generators are essentially a source of content creation for an interest, such as sites like YouTube, but can also include more interest specific spaces (Gee, 2005; Lindgren, 2012). This content creation usually involves some form of internal grammar that is to some degree unique to the affinity space. This research does not look at the fine- grained differences between Portals and Generators but it is important to understand the difference between these different components of affinity spaces. Portals are access points that provide people with the ability to interact with content from the generators. A specific affinity space can be one or the other or both a Generator and Portal (Gee, 2005). A sticker being used either in a generator or portal might look different due to the intended audience being potentially different. A sticker might be mostly used as part of Portals, in other words as a way to communicate. But a sticker might be used in a Generator as part of the process of mixing ideas together using visuals.

On some level, the Expressions Group was trying to grapple with this concept. What role does the sticker play? The youth framed this argument as “Do the stickers need to reflect the specific interest?”, in other words do they need to be a product of the interest? While the group was not intending to describe Science Everywhere as an affinity space, their discussion about how the stickers must be connected to Science Everywhere as an interest implies some level of understanding of this concept. The Expressions Group essentially framed Science Everywhere as

a Generator affinity space and were trying to find a way for stickers to act with a Portal space of some sort to help them describe their Science Everywhere Interests.

It is important to understand that there are differences between communication between different audiences (Gee, 2007). In other words, the jargon or language that requires a set of content knowledge won't really work when communicating to people unfamiliar with the interest at the heart of an affinity space. Just like you need to have some knowledge of science to understand scientific concepts, you need to have some knowledge of an interest to be able to engage more closely with that interest. Stickers being used to communicate an interest will also have this content knowledge requirement. However, there may be ways to better help a sticker bridge the interest into a new context and allow it to more effectively help someone start to communicate their interests.

While affinity spaces describe the structure of the spaces and how the interest is communicated between various groups of people, it on some level assumes the form of the communication between people in the space. This communication is also assumed to have a grammar or rules to describe how people exchange ideas. If stickers can be used in an affinity space to communicate, this then creates the question of what rules stickers have and how these rules are created and described.

One way to think of stickers that helps explain the how stickers might be used to communicate between people inside of and outside of an affinity space is as Boundary Objects. Boundary objects were originally described as a way for information to be translated from amateur to professional between communities of practice (Star & Griesemer, 1989). The theory is often used to describe an object that can exist and pass through the barriers of different

communities (Star, 2010). The requirements are that the object needs to be used by both communities of people who are communicating and that they are able to negotiate some shared meaning for the object.

Stickers could be a type of boundary object to help communicate information about an interest outside of an affinity space. Stickers are known by people in general and are socially accepted in many different contexts. I will go into this more in detail in RQ2, but the participants of the study did describe their familiarity with stickers in many different contexts. Thus, stickers can likely be used to describe a personal interest in one context and be used to start discussion about it in another context.

The CoD Group produced stickers that contained rich information about their interest, in this case a media-based interest. The Expressions Group produced stickers that helped to illustrate abstract information about emotions that are necessary for understanding the importance of an interest – when working in conjunction with other boundary objects. I will be using this lens in the next section while discussing a few specific exemplar youths. The exemplar youth could use one, both, or neither of these styles of stickers to engage or communicate their specific interests.

Focal Youth Interests. Now that I've described how the stickers are connected to interest, I will connect the details of the personal and everyday interests of the four focal youth. These connections with their everyday lives will help connect to the sub-question that focuses on how youth connect their interests to place, specifically the places and spaces that are important to their interests in their everyday lives. The focal youth each had a slightly different focus for their interests and how they connect to them. These different interests and spaces come out in their

explanation of how they would use stickers that they (or others) created as part of the design session. The interests from the interviews can be roughly connected to the ways they designed and used the stickers. The categories are exemplified by the interests and strategies of four different participants. The categories are:

1) Enrique, a member of the CoD Group, was focused on how he could find new interesting things by working for a company. While Enrique primarily described specifications for his interest, he didn't provide much in the way of detail of why exactly he was interested in something. I will look at potential ways for him to possibly express his passion.

2) Marcos, a member of the CoD Group, was focused in his interviews on how to share what he built with others. This desire could benefit from some better exploration of in vs out group communication.

3) Jasmine, a member of the Expression Group, could likely use either the Expression stickers or another sticker pack similar to that of the CoD Group to help express emotion around their interest in a television show to her parents who are an out group.

4) Isabel, also a member of the Expression Group, might not have a use for any of the stickers, even though she expressed instances of being interested in a media interest similar to that of the CoD Group and a place interest more similar to that of the Expression Group.

Stickers Drawing out Passion. When thinking about stickers augmenting place, the focal youth Enrique was the most focused on a place – working at Microsoft. What would he do at the place? He would find new answers to questions. He, unfortunately, did not detail explicit reasons for this rather specific desire.

Enrique hinted at important details in his interview but did not explicitly state why he found things interesting, just what he found interesting. The important parts that defined something interesting to Enrique were novelty and “being an adult”. The case for novelty or newness is not exactly surprising as it was also reflected to some degree in the interviews of the other youth. What is interesting is how Enrique connected his desire for novelty also as an asset he had that he wished to share with others. He desired to share his ability to create new things in the form of working in the tech sector for a company (i.e., Microsoft).

Working for Microsoft is more of a place for the interest than an interest itself. He was interested in creating things at Microsoft but did not go into detail about what Microsoft was doing. These gaps in his discussion about what he finds interesting aren’t surprising. He may not be able to discuss the details for a number of reasons.

On a superficial level, Enrique’s desire to find new answers while working at Microsoft and a sticker pack do not really seem connect to any emotion or passion other than a desire for novelty. It is important to remember that while designing the CoD Group stickers, he displayed a fair amount of passion and drive while effectively playing with stickers about his interest. The question becomes how can stickers help him to express that passion and better identify the drive behind his interest? While it might seem logical to use something similar to the CoD sticker pack, that may not work. The CoD stickers required definitive representations of the interest that may not be available for a nebulously defined goal of finding novel answers at Microsoft.

Instead, something similar to the Expressions Group stickers might work better. These stickers modified aspects of the place and thus did not need to have specifics about the interest in them. Instead, the Expressions stickers were about connecting the person to an interest or place.

Remember, the Expressions stickers, while more about the emotions of people than the place, were used to provide information about what happened in a place, Science Everywhere. This is where Enrique could potentially use such a sticker place, by self-inserting his feelings into representations of what he finds interesting – about Microsoft or some other job. It could help him to identify important parts of his interest and open a discussion that might help him to find support or new insight about his interest.

In a rather literal sense, the Expression Group stickers could help Enrique express information about “why”. Did he find a particular activity fun or was it boring? The stickers could potentially provide the means to do that. For instance, what if he used stickers at the place that helped him learn about how to apply for a job at Microsoft? It might provide more insight into what he was doing and what exactly he might find interesting other than novel answers.

We saw this happen with the Expressions Group. They expressed some new information. For instance, one might assume they were having fun if you looked at the group of youth playing Minecraft. However, the stickers showed that they were in fact frustrated. The stickers provided useful new information that prompted discussion about what happened during that activity.

That isn’t to say Enrique must use the stickers to express his feelings about an interest. Still, this sticker usage needs to be further explored. Stickers being used to help a youth label their emotions or desires to place-based activities could be useful to help start conversations about the interests they engage with. Thus, Enrique’s stated desires in the interview are likely mostly consistent with the Expressions Group sticker pack for helping him to start conversations about his everyday interests. I will explore the usage of stickers in a place-based learning setting

in more detail as part of RQ3 (unfortunately without Enrique as a youth in the event due to him being unavailable).

Stickers Facilitating Social Interactions. Another goal is stickers facilitating social interaction and not just surfacing important information about an interest. The focal youth Marcos mostly explained his interest in terms of social interaction. Marcos's desire for social experiences and interest-driven collaboration with others could make use of something like the CoD Group's stickers. While Marcos did help design stickers as part of the CoD Group, the likelihood of Marcos using the stickers is also connected to how he used the CoD stickers.

The CoD Group stickers were used by the youth to build collaborative narratives. For instance, they created a scene where they were shooting zombies that were invading a watershed. They also put Xbox Live headsets on photos of themselves to connect their playing Minecraft to how they play CoD. This kind of layered usage of stickers to build something larger than a single sticker is an important potential way to use stickers.

Marcos's repeated description of wanting to share things he created is important. Part of the implied limitations of his sharing involved having to share a physical thing and then involving people in further creation of that thing. The question becomes, what if Marcos was able to recruit people to build with him beyond just a physical place? This starts to get into aspects of affinity space generators. If Marcos would use stickers to both build and communicate ideas, it would potentially be similar to how fanfic communities write stories about their interests. Rather than being the written word it would be more connecting ideas symbolically. This happened during the CoD group where they not only created a story using stickers but also conveyed important information by using specific details like the importance of the color gold.

One detail that needs to be further explored is the dynamic when interests (and associated stickers) from multiple media-based interests are combined. We saw a bit of this in the CoD Group where a Minecraft sticker was created to reflect the photo depicting playing Minecraft. However, it isn't known if the added complexity of mixing interests from different affinity spaces (i.e., CoD and Minecraft) would have resulted in a more general exploration of games as interest or if CoD would remain the primary interest – or even another, unknown outcome. While the added complexity of communicating multiple interests at once could result in an interesting analysis of the youth's interests overall, it does not appear to be a primary concern of the youth themselves. Marcos appears to be mostly interested in building and sharing discrete interests with others not in his immediate group rather than connecting all of his interests at once.

Marcos could use stickers in such a way. The question remains how would he use stickers like this practically? In Marcos's descriptions of the interviews, he implied the importance of place by using phrases like "I mean if we were here" to frame sharing, in this case at Science Everywhere. He did connect to the Science Everywhere app, so he isn't opposed to using an online space. He just doesn't appear to be able to describe what that looks like. This question of how stickers can be used to engage with an interest with a collaborative narrative will be explored in both RQ2 and RQ3.

Place-Based Media Interests. Jasmine's interest in a television show likely could work with either style of sticker pack. The CoD Group sticker pack describes a media-based interest, and the Expressions Group sticker pack describes the emotional importance of a place-based interest. Jasmine's interest in watching a television show, "Naked and Afraid", contains both these components.

The interest is about a specific television show. This television show is a media property like the game CoD. There are narratives and events around both and conceivably there could be a pack of stickers about the show Naked and Afraid just like how the CoD Group created stickers about the video-game Call of Duty. With these stickers, Jasmine could describe details about the television show or even favorite episodes, just like the CoD Group described gameplay scenarios.

Jasmine could also describe aspects about how she socialized about the show. This social experience about the show was described as taking place at her home. Jasmine described how she felt about the show and what kinds of conversations she would have with her family members. These kinds of conversations could be compatible with stickers by, for instance, placing their opinions on specific scenes or happenings in the television show.

Effectively, Jasmine could use stickers in two different ways around the television show. She could use stickers to (re)create aspects of the show using stickers that reflected important parts of the show. Exploring parts of the show could help surface details about what Jasmine is learning. On the other hand, Jasmine could also use stickers to explain what parts of the show she finds interesting or engaging. By more directly labelling the parts of the show it could also be more apparent what parts of her interest could be further explored. The key detail that would need to be further explored is how to express this to her parents who are likely not as familiar with the show as she is.

Essentially, both design group options could work to connect with Jasmine's interests. The question is which one would work best to communicate with what people? Jasmine already talks about how she socializes about the tv show with family members of a similar age to her but

not with her parents. It isn't known which type of sticker interaction would work best to communicate Jasmine's interest with her parents. How can stickers connect a youth's interest with someone who does not necessarily have much or any knowledge of the interest? I will explore this question in more detail in RQ3.

None Of the Above. Isabel's potential usage of stickers could be simply described as "none of the above". Isabel had a very controlled framework for sharing her interests. The interests largely remained contained to a specific face-to-face interaction or digital sharing application. This would likely make integrating a media-based sticker like those made by the CoD Group difficult. She did not state a desire to share and explore an interest outside of how she was already engaging with the interest. Similarly, the more emotions-based stickers of the Expression Pack might also represent a problem for Isabel. The "emotion" she seemed to be emphasizing the most was that of humor.

Interestingly, this is how Isabel consistently used stickers. Her sticker usage was more as a practical joke where she would use the affordances of the stickers in iMessage to essentially edit an iMessage text from a friend to make it say something else. The friend would then become confused by their message appearing to be different from what they sent. This isn't really an interest driven usage of stickers in the sense of it helping Isabel to communicate an interest. In a sense, using stickers to make a joke was the interest. This does seem to indicate that Isabel is open to the possibility of using stickers. It is just unclear how she could use stickers to share an interest. How Isabel used stickers might indicate the limitation of using stickers for Isabel is more about how she socializes and shares information from an interaction dynamics perspective than not being able to use stickers with her interests.

Summary

The exploration of interest and stickers has surfaced a few ways stickers could be useful to help youth communicate. My findings suggest that stickers, such as those designed in the CoD and Expressions Groups, can be used by youth to highlight important aspects of their everyday interests. The four focal youth each have important takeaways to consider when using stickers to communicate interests.

1) Some youths are focused more on communicating the requirements for something to be interesting to them. The Expressions Group stickers helped to illustrate this importance using expressions to illustrate emotions. It can sometimes be difficult for adolescents (and adults) to express their feelings about an interest. For youth like Enrique who have important requirements for their interests, stickers should help to surface when and where these requirements are being met (and not met).

2) Stickers as a medium for communication have a strong social component. The CoD Group used stickers to collaboratively build around their interest in the CoD video game. When stickers are being used to collaboratively build upon an interest, it is important for stickers to provide building blocks related to that interest in a way to help the users share (i.e., CoD stickers depicted items from the CoD games). It is likely best if these sticker packs remain focused on a single theme or interest to help youth like Marcos to stay focused on narrowing down their interest while sharing.

3) Sometimes both the more interest-focused style and the more emotions expression style of the CoD and Expressions stickers, respectively, can work for a youth. At which point an understanding of who the youth is talking to needs to be considered. Jasmine gave detailed

examples of how she connected her interest in a television show with similarly aged family members. It remains to be seen if either of these packs can work to communicate her interest with her parents.

4) Similarly, it is important to understand when a youth may not want to share their interests more broadly. Stickers used to help communicate their interests may not be necessary and they may instead focus on smaller interactions. Isabel did not express a desire to communicate her interests more widely outside of the immediate activities about the interests. However, Isabel did use stickers within a social group which could indicate some utility for stickers, as long as they fit her immediate needs to communicate.

These insights from the focal youth are the first steps toward better understanding how stickers can be used to communicate everyday interests of youth. These interests that often come from an affinity space such as the video-game CoD or a television show like *Naked and Afraid* can provide the youth with a space to not only engage with the interest but potentially explore and learn. It is important for youth to be able to share or communicate these interests to not only be engaged with their everyday interests but also to potentially be able to assist them with any learning opportunities.

Unfortunately, most affinity space literature focuses on written or verbal means of communicating about the interest. While there are visual forms of communicating, they are often in service to these written and verbal forms such as online video streaming or memes. More symbolic forms of communicating aspects of the interest such as stickers are not as well defined. Affinity spaces are useful to describe these interest spaces because of their ability to describe and connect with what is being communicated. By better understanding how stickers can be used by

small groups or even individuals to express interests we could potentially better understand these interests. In the RQ2 and RQ3 chapters I will explore some of the questions from RQ1 about the nature of how stickers can be used by youth to share their interests while helping to facilitate more rich face-to-face communication.

Chapter 6: RQ2 - Sticker Language

In this chapter I look at how youth use stickers as individuals as they organize and then communicate their ideas face-to-face while using sticker to illustrate. Specifically, I will look at how the *constraints and affordances* of sticker design impact *sticker usage patterns* of participants while sharing and exploring their interests. This will be separated into two concepts of (1) how patterns of sticker usage suggest a vocabulary for stickers and (2) how *sticker vocabulary* can be used to combine ideas and create rules for a *sticker grammar*. Using data from a co-design session and interviews, I will show how youths used stickers to form a dynamic *sticker vocabulary* that I define as applying a set meaning to a specific sticker. I will then show examples of how youths used multiple stickers together to explain stories (i.e., a *sticker grammar*).

I will then present implications based on the descriptions by the youths as well as the use patterns based on the design artifacts. The discussion of these implications includes how youths apply personal meaning – including representations of self – to specific stickers and how the use of the stickers in proximity to other visual objects impacts their ability to explain more complex ideas. I will close the discussion of RQ2 with sticker design suggestions based on an extrapolation from those implications and with a focus on how the designs around sticker usage should think about these patterns of sticker usage.

Findings

I will first describe my findings in terms of youths' *sticker vocabulary*, with data from the *Idiom Activity* and *Story Design Session*. I will then show more complex examples of sticker

usage that illustrate how youths created *sticker grammar* while telling stories or retelling events. *Sticker grammar* will be illustrated by the example of the Animal Group from the *Sticker Pack Design Session* followed by more detailed examples from the *Story Design Session*. The Animal Group is being used to provide a representative example for illustration purposes as they discussed different ways that they equated ideas to specific animals. How the youths in the Animal Group designed stickers to illustrate ideas is important for understanding how youths used stickers to compose and retell their stories during the *Story Design Session*. I will provide some illustrative examples from a selection of youths from the *Story Design Session* to describe strategies that the youths were using to compose their ideas using stickers.

Sticker Vocabulary. To start I will detail the concept of a *sticker vocabulary* and what that looked like when youths used stickers. While I will be detailing some examples of *sticker vocabulary* it is important to keep in mind this is neither an exhaustive representation of a *sticker vocabulary* nor a common one. I will describe *sticker vocabulary* in three sections based on themes identified in my analysis of the ways youths used stickers: (1) Word to Sticker (using a sticker to replace a word or set of words), (2) Sticker Worth a Thousand Words (using a sticker to visualize a more abstract concept that may be difficult for youths to explain with few words), and (3) Sticker and Self (stickers being used to represent themselves or others).

Word to Sticker. The first strategy for understanding how youths and their parents could develop a vocabulary of stickers is to structure a basic activity that encourages linking a sticker with a word. To explore how they might use stickers to communicate a word, the youths were tasked with sending one of their parents an idiom composed of a combination of stickers and written words. The task to communicate idioms was chosen as a way to encourage using stickers

in a way that would require interpretation between a youth and their parent while they negotiate the meaning of the sticker. The task was framed to encourage using stickers as a 1:1 replacement for words as part of an idiom of their choosing to help scaffold learning how to use stickers to communicate.

One initial result from the idiom exercise was that parents could replicate using stickers as part of an idiom when it was initiated by their children without direct instruction by the researchers. The youths were instructed on how to use stickers to communicate an idiom and then asked to communicate with their parent face-to-face about the digital stickers. The parents were able to understand and then reply with an idiom of their own while using stickers.

The ways that youths and parents interacted around using the stickers provides some insight about how they communicated ideas with stickers. Below are a few representative examples of the idioms made by the youths and parents. Additional details of what the youth and parent were thinking about during the activity and about the activity are from the post activity interviews. The interviews provided extra details about how the youths and parents approached using stickers or other images to replace words, as well as how they discussed the digital stickers face-to-face.



Figure 10: a) Jasmine’s idiom that she shared with her mother was “Speak of the devil” where the devil was replaced with a devil emoji sticker. b) Her mother shared back “You are pulling my leg” with the leg replaced by an image of a leg.

When asked about conversing with her mother about the idiom there was a technical barrier to her mother understanding how the emoji sticker worked. Jasmine thought her mother understood the idiom but didn’t know how to reply back with her own stickers.

108: Jasmine Yeah, but I had to help my mom out a little bit. She didn’t really understand. She had the idiom, but she didn’t know how to use the sticker.

Jasmine then tasked her sister with helping her mother, Sierra, understand how to use stickers. This conversation resulted in their mother posting a leg sticker or image as part of “you are pulling my leg”. Before the explanation, their mother, Sierra, did not know how to use a sticker and texted idioms back to her daughters without using stickers.

80: Sierra It’s, they were communicating with me on that. The first time I didn’t get it. Then when I realize what it was, it was a little bit funny because I think the stickers just a way of communicating. In using a different form

of expression, if I may do that, but it's an expression which already exists, but you are making the mind work to try to complete whatever is missing to what is expressed there. I don't know if that makes sense or not.

Here Sierra shows that she did appear to understand what her daughters were doing when texting her the idioms. As she said the stickers were a “way of communicating” that was a “different form of expression”. Once she realized she needed to think through new connections she was open to the idea of trying to connect even more ideas. Sierra explained that using stickers was almost like using another language to communicate. She compared it to speaking in Spanish.

86: Sierra No, when she came up with this one, so I came up with this one, because I even mentioned to her as we were coming, and I said, “Oh, actually you have another one in Spanish,” because this is more links us to people's culture the way you express yourself.



Figure 11: Naomi shared the idiom “The ball is in your court” with a cat with a basketball replacing “the ball” while Naomi’s mother shared “Piece of cake” with an image of a cake replacing the word “cake”.

Not all parent and child pairs understood the task as involving translation. Naomi and her mom Kalani ran into some problems while doing the idiom exercise. While they both used stickers or images to complete idioms (e.g., “[Ball] is in your court” for Naomi and “Piece of [cake]” for Kalani), Naomi and Kalani were not convinced of the utility of using stickers. Kalani believed the stickers lacked clarity of the meaning.

96: Kalani Yeah, it’s not like clear to me. What [is Naomi] trying to tell me?

Kalani’s quote suggests that in this instance she desired for communication with stickers to not require a conversation to understand their meaning. While they both were able to complete the activity of using stickers to retell part of an idiom, they both still seemed skeptical about why they should use stickers.

Overall, the *Idiom Activity* limited using a sticker to replacing a word. While the idioms were somewhat abstract in nature, the usage of stickers was still highly structured and meant to create a direct link between a sticker and a word. While these idiom examples showed how

people can use stickers as one-to-one replacements for a word, this leaves open the question of whether people might find more utility using stickers to communicate ideas more complex than a single English word.

Sticker Worth a Thousand Words. In this section I will describe how a sticker can be used to mean a phrase or collection of words. This is in contrast to how the previous representative example of the idiom exercise showed youths and their parents using stickers one-to-one in place of words. It is important distinguish between a sticker acting like a replacement for a single word and stickers representing more complex ideas that would normally require several words, if not sentences, to describe.

To do this I will detail representative examples of sticker usage from the *Story Design Session*. This session was designed to encourage more freeform sticker usage in the context of telling a story or recounting a previous event. The youths were given a selection of stickers that ranged in complexity. While many stickers were relatively simple, such as depicting a single object (e.g., a ball), the youths still used the stickers to represent more complex ideas than merely representing a ball.

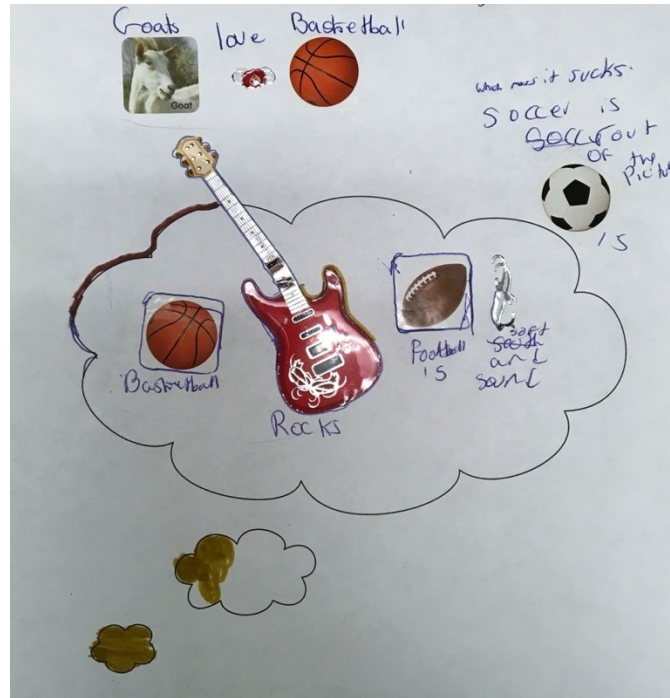


Figure 12: The youth Damien used a sticker of a guitar to represent “rocks” in the phrase “basketball rocks football” composed of three stickers.

For instance, Damien used stickers to represent words, similar to the idiom examples. The sentence “Goats love basketball” is a seemingly simple 1:1 direct replacement of the words. This sticker sentence could be interpreted as a statement about an animal loving basketball. Damien’s other sentence similarly used three stickers to replace words. However, the sticker of an electric guitar was used to represent the word “rocks”. In this case the word “rocks” is used to reference how much they like something (i.e., how “cool” something is) rather than it being associated with rock and roll music. This is still effectively replacing a word with a sticker, but it is doing so by essentially mixing metaphors of rock and roll the music with the idea that rock or rocking is cool.

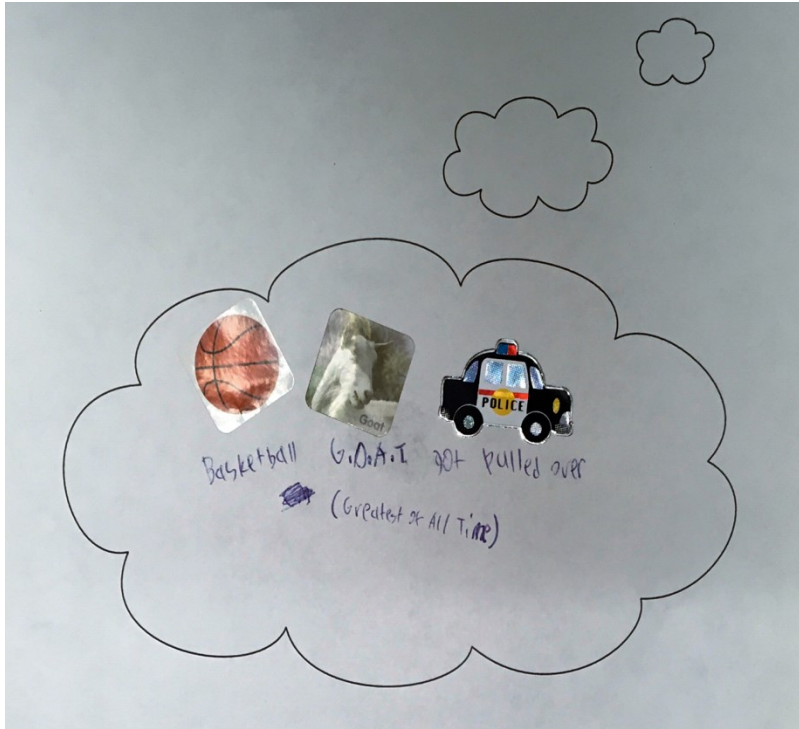


Figure 13: The youth Booker used three stickers to make the sentence “Basketball G.O.A.T. got pulled over” where a basketball sticker meant “basketball” a goat sticker meant “G.O.A.T.” and a police car sticker meant “got pulled over”.

Booker created a similar three sticker “sentence” as Damien. This sentence reads as, “Basketball G.O.A.T. got pulled over [by the police]”. While the basketball sticker was used to replace the word “basketball” (the sport), the other two stickers were more complex. The goat sticker, also used by Damien, is now directly referencing not an animal but rather the concept of a person who is the “Greatest Of All Time”, or the acronym G.O.A.T., as explained by the text next to the sticker. This brings up an interesting illustration of a problem with mixing metaphors and stickers. For instance, Damien also used “goat” with his similar usage of stickers. However, he did not explain if he meant G.O.A.T. or the animal goat like Booker did. Why Damien used the goat sticker was not mentioned in the oral conversation during the session either.

This example shows that by not providing clarification or sharing a similar cultural context, the meaning behind sticker usage could remain cryptic. Another illustration of needing this shared context or needing to seek clarification involves the usage of the police car sticker. This police car sticker stood in for a similarly complex concept of being pulled over by the police rather than police in general. These stickers show the potential complexity of understanding the definitions behind stickers. The three stickers were described in three different ways – a word replacement, an acronym replacement, and attributing an action to an object.

Having stickers replace more complex ideas that would normally be conveyed using at least a phrase in the English language starts to show how understanding or sharing context is important. The usage of stickers to share ideas overall had different degrees of context ranging from being able to understand jargon such as G.O.A.T. to more nuanced assumptions. Being able to read or understand the vocabulary of the stickers seems to require some understanding of the context of the person using the stickers.

Sticker and Self. In the previous section I discussed how to read the meaning of stickers and I noted the importance of understanding context. One important context to understand is how youths describe or illustrate their idea of self while using stickers. The idea of self was important to the more complex stories told with stickers. Rather than merely making a three-sticker statement about something, these youths described details about themselves and others (often their friends). When youths were describing people they often (but not always) used stickers representing more than one object. Instead of depicting a single object like a basketball or electric guitar, these stickers often represent multiple objects or an animate entity (e.g., a cat holding an umbrella in the rain). I will provide examples of how the youths used stickers to

represent aspects of self (e.g., feelings or emotions). One way that youths represented the idea of self was by illustrating personality traits.

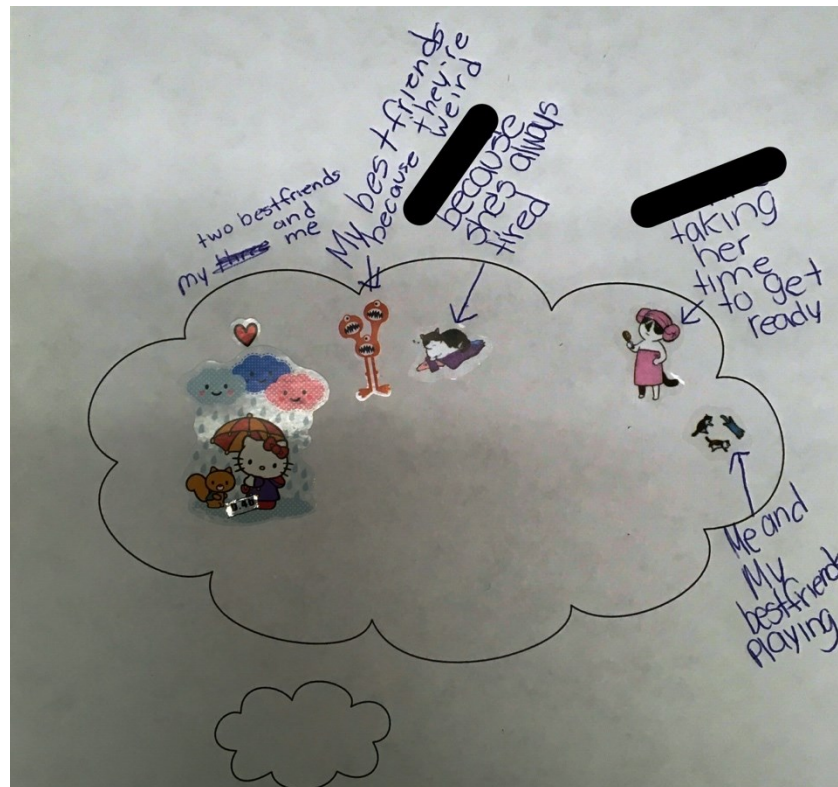


Figure 14: The youth Elena used stickers that represented her friends by assigning them personality traits such as a cat in a shower cap resenting “taking her time to get ready” and three cats playing representing best friends playing.

Elena used stickers from a cat themed sticker pack. Rather than use these stickers to create a sentence or tell a story she used them more to describe herself and her friends. For instance, she used a sticker of a cat napping on blankets to represent a friend who is “always tired”. She used a sticker showing three cats seemingly chasing each other to describe her and her friends “playing”. Of course, Elena and her friends are humans and not cats, so it is understood that there the stickers are being used symbolically. The stickers she used for these descriptions are largely personified animals (e.g., a biped cat in a bath towel with a shower cap rather than a cat licking itself clean).



Figure 15: The youth Amelia used stickers similar to Elena where the stickers stood in for traits or events such as the stickers of Winnie the Pooh being friends or a shoe meaning the time Amelia asked a friend for help.

Amelia used stickers similarly to Elena. For instance, showing characters from the Disney property Winnie-the-Pooh being friendly represented a friend group. However, some of the metaphors used to describe herself were not as direct. For instance, Amelia used a sticker of a campfire to describe when she is “getting mad”.

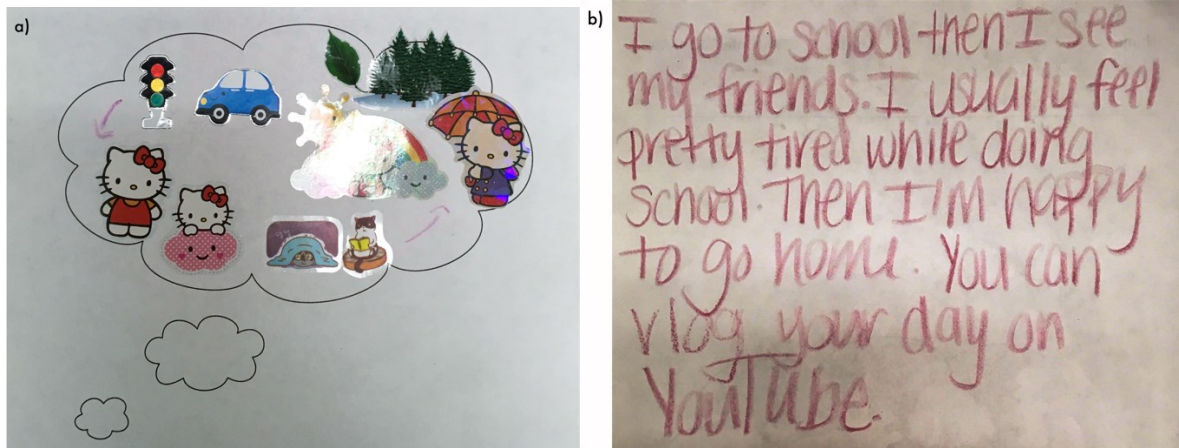


Figure 16: Sabrina tells a cyclical story of going between school and home using stickers to represent people and events.

Sabrina used these kinds of metaphors together to essentially describe a fictional day-in-the-life. This included concepts like feeling tired and going home being represented by a cat under a blanket or the concept of school being a cat reading a book. This example starts to use these metaphors that explain her feelings in a way that describes a larger context – her everyday life. I will look at examples similar to this in the next section to better explain how stickers are used together with a *sticker grammar*.

The youths tended to use some combination of metaphors and comparing themselves to an established character, usually from a media property such as Winnie-the-Pooh. These comparisons require some knowledge, not just of the context of the youths, but a wider knowledge of the media landscape that the youths are a part of. This media connection was previously seen in the RQ1 chapter so it is not entirely unexpected that the youths would continue to connect themselves to the media they consume. It does continue to support the importance of understanding media interests when decoding the meaning behind stickers used by youths.

Sticker Grammar. As detailed above, youths created a kind of ad hoc vocabulary with stickers. I will look in more detail at how they used this vocabulary. I refer to this as *sticker grammar*. In the previous section, while describing *sticker vocabulary*, I used an example of how stickers can be used similarly to emoji. While emoji and stickers can serve similar functions, it is important to remember that stickers are, however, not emoji. There are different affordances and constraints that impact the usage of stickers compared to emojis. The most critical difference is that emoji are characters used in-line with text while stickers can be placed on top of text or images (or other objects in the case of physical stickers). There is some overlap between the two (i.e., an emoji can be turned into a sticker), but the distinction is important due to how stickers are used.

Emoji are mostly used in-line with written text and thus largely are either integrated into the grammar of a sentence or appended to the end of a sentence to provide contextual detail. Similarly, *sticker grammar* allows for youths to describe things. However, stickers are “stuck” on objects and do not necessarily follow the grammar of an associated sentence. Effectively, stickers can have their own rules that direct usage and, importantly, how to read or understand the sticker. We saw simple examples of this in the *sticker vocabulary* section where they formed relatively simple sentences. In those examples stickers were placed next to each other proceeding left to right, similar to an English sentence.

While the previous examples were essentially replicating the grammar of an English sentence, I provide examples of different ways stickers can be associated. I will provide details of how youths made these more complex stories with stickers. These more complex stories

involved the youths retelling longer stories or they recount contextual details of an event that happened to them.

I will detail the *sticker grammar* in three sections that describe the usage of stickers through: (1) Sticking: Context from Placing Stickers, (2) Sticker Proximity: Degrees of Connection between Ideas, and (3) Narrative Structure: Using Stickers to Tell a Story.

I will open this discussion of the *sticker grammar* in the section *Sticking: Context from Placing Stickers*. In this section I will provide examples of how the stickers can be used with each other or the image (or text) they are placed upon to add context. Placing a sticker on a photo can provide context about details of the photo. This section will include examples from the Animals Pack made during the *Sticker Pack Design Session*.

The remaining sections will include data from the *Story Design Session* to provide examples of different types of sticker associations. In the *Sticker Proximity: Degrees of Connection between Ideas* section I will look at how stickers can be used near another object (or sticker) to associate multiple ideas with each other. I will also provide examples of how stickers can be used on top of an image or other sticker to create a larger whole. This can merge the ideas of the stickers or create an entirely new idea based on parts of what the other images or stickers represent.

Finally, in *Narrative Structure: Using Stickers to Tell a Story* I look at how stickers can be used as part of a narrative of a story. This includes using things like written words or lines to help guide the narrative being described by the stickers. Essentially, this looks at the additional supports the youths created to help guide how to read the narrative.

Sticking: Context from Placing Stickers. To understand how stickers can have a grammar we need to look at how they are used. Stickers are primarily thought of as being placed or stuck on or near something either real or illustrated. For instance, not only can you place a sticker on a photo, but you can place the sticker on something that is illustrated by the photo.

As previously discussed, the Animal Group was a representative example of how youths would use stickers to represent concepts. In this section I will expand upon and look at how they not only used stickers to represent a concept but how the sticker usage had rules or organization that could be called a grammar. As a reminder, the Animal Group during the *Sticker Pack Design Session* was focused on creating animal stickers. They then used those animal stickers to create or illustrate metaphors in combination with the photos they “placed” the stickers upon.



Figure 17: The Animal Pack sticker group from the Sticker Design Session used their memories of the photo such as by adding a sticker of a bird where they see birds and also making a metaphor such as having sticker of a pig where the grass becomes muddy in the rain.

In this photo the group created a variety of animal stickers. When asked about why they placed certain animal stickers where they did, it often involved some kind of link between the nature of the animal and the specific spot of the photo. In a discussion with an adult facilitator, they were able to verbalize these connections.

169: Kelly Okay, so now let's talk about the stickers before we pass them again. So, let's all talk about the sticker we added to this picture which is a tree at Solid Rock. So, who did this?

170: Elena Because there is like, muddy when it rains.

171: Kelly Okay.

172: Elena You know, then it's like ...

173: Kelly Then why the pig?

174: Elena Dirty.

The pig was added to a part of the photo of a post that was muddy after the rain. Note that the photo did not depict any mud, it relied on their memory of the location. Associating a pig with mud is also an important link that might not be immediately obvious. Other animal pack stickers, though, had different connections to the content of the photo.

183: Kelly Okay, why'd you add the bird?

184: Elena I don't know, because there's a lot of birds that sometimes go by trees or like, benches and stuff.

They recalled they saw birds at a specific spot, so they added the birds back in the photo using the stickers. There was no metaphorical meaning like with the pig. Instead, it was purely knowledge about the location they knew the birds preferred.

A member of the group then went and shared their stickers with the Expressions group. When they came back from explaining their stickers to another group, the group also saw the animal stickers as metaphors for emotion.

596: Elena We didn't really talk about that, but we talked about she said she would use the puffer fish for when someone is maybe like shocked or scared.

[...]

605: Elena She said the monkey is always for crazy stuff, and they were always jumping around, and she would use that for when someone did something crazy. A bird for like someone is having a bad day.

The Puffer Fish and Monkey sticker ideas are similar to those of the Pig sticker created by the Animal Group. Instead of giving contextual detail about a place (i.e., the pig represented that the ground became muddy in the rain) the puffer fish and monkey stickers focused on the goals of the Expression Group – explaining people. These stickers relayed hidden information about people in the photos rather than of the place. For instance, a puffer fish expanding and becoming spiky when it is scared indicates fear that could be used to describe a human being afraid. It is likely the Expressions Group members placed the Puffer Fish sticker next to a photo of a person who was scared (similar to how they used their stickers as seen previously in RQ1).

These examples showed some of the more basic ways of organizing stickers to convey meaning. In these instances, the act of using or placing a sticker helps to provide context clues that are useful for understanding the definition of the sticker. This is not too dissimilar from understanding the definition of an English homonym by using contextual clues. By using contextual clues this can help to solve part of the context problem described in the *sticker vocabulary* sections.

Sticker Proximity: Degrees of Connection between Ideas. In the previous section I described how rules for sticker usage that were described by the youths could be thought of as a grammar and provide needed context for understanding the stickers. In the following section I will expand on some examples that look at some more specific rules for sticker usage. Specifically, in this section I will look at how spatial association, a sticker being near something, is important. These specific examples of *sticker grammar* are from the *Story Design Session* where youths were tasked with retelling a story using stickers. There were quite a few examples where stickers were placed near to each other so I will be providing some representative examples of the most common usage styles. The most common way to they used stickers together involved close placement that implied an association or order of events of the story based upon how close the stickers were to each other.

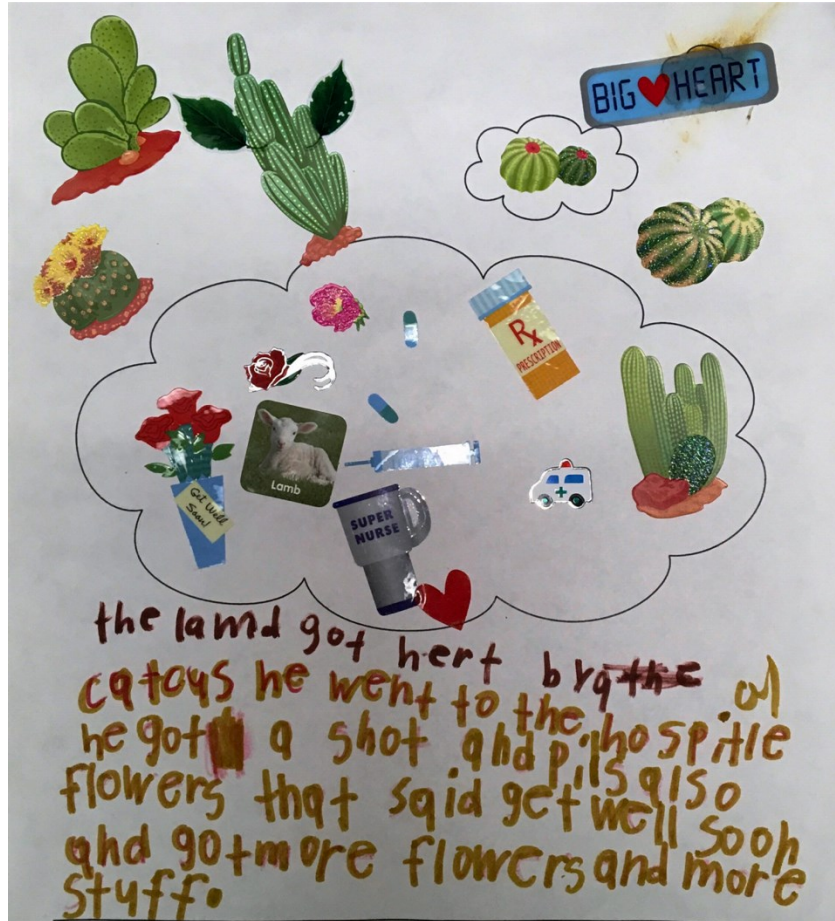


Figure 18: The youth Ana tells a story of a lamb getting a shot at a hospital while using a needle sticker to poke a lamb sticker to illustrate the fictional story.

In this instance, Ana is telling the story of a sick lamb. To do this they placed the sticker of the lamb next to the sticker of a syringe. By placing the syringe immediately next to the lamb, it implies the lamb is being injected by the syringe. In the story the lamb went to a hospital and received treatment for being injured by the cactus.

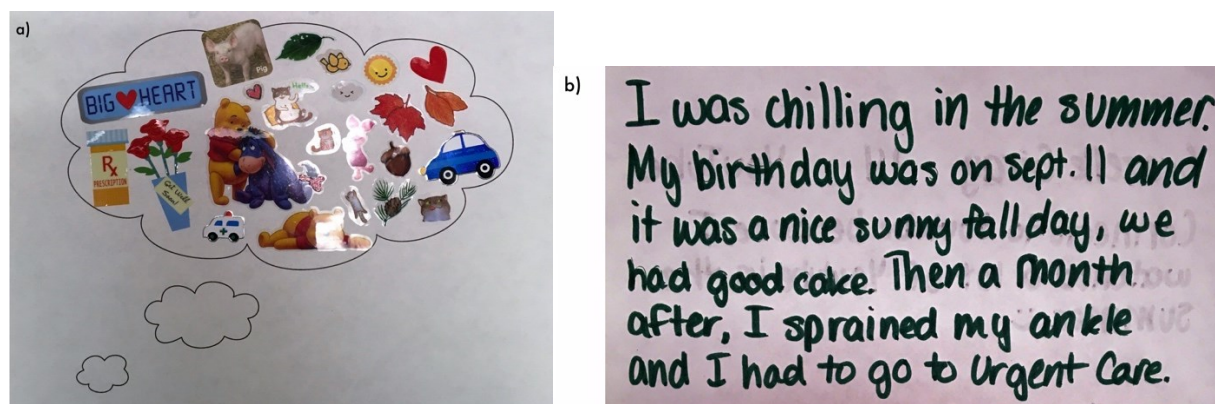


Figure 19: The youth Naomi details two events with stickers. The right side is more just hanging out in the summer and the left side describes a hospital visit that happens after.

In this example from Naomi, she does something very similar in that her story describes a visit to a hospital due to an injury. The stickers depicting people (e.g., Winnie-the-Pooh) are central while other stickers depicting a fall day and going to the hospital surround it. The fall stickers and the hospital stickers do touch but don't mix with each other. This is similar to how the fall day leads to the visit to the hospital, but they are not the same event in the story.

However, sometimes stickers were combined together to create a larger whole (i.e., unity). When the sticker is overlapping another image, text, or other sticker it creates a potentially new meaning beyond mere proximity. Often, when youths connected the stickers in the story session it resulted in merging the meaning of the stickers. A few youths created entire scenes using stickers. One such by the youth Jasmine scene had quite a few merged ideas using metaphors.

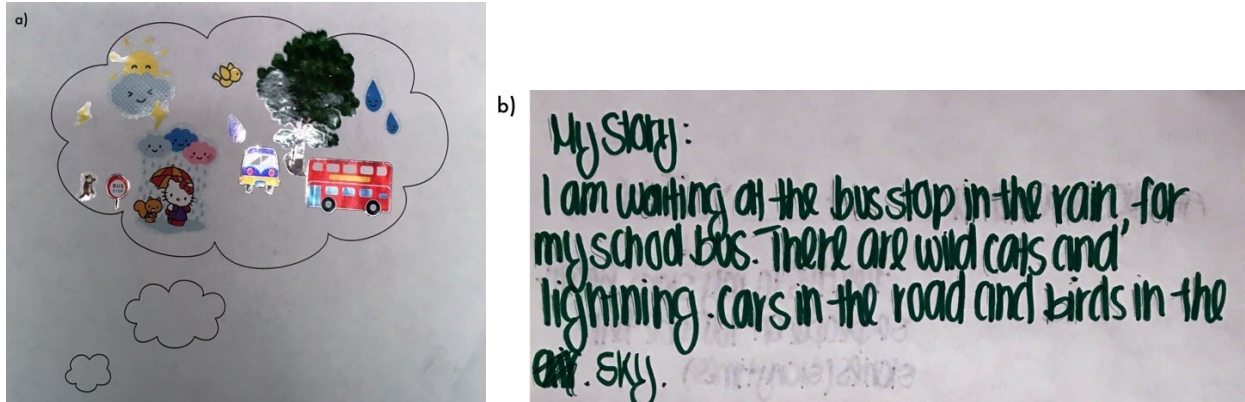


Figure 20: The youth Jasmine used stickers to illustrate a static moment in time. This scene involved waiting at a bus stop using stickers to represent parts of the scene.

Jasmine used stickers not so much to retell a story with action but to illustrate a scene.

There was no narrative or action, but rather the combination of stickers conveyed a single moment. The scene involved waiting for a school bus in the rain, with different stickers with various levels of proximity to each other and all within the thought bubble that came on the piece of paper. The rain and the animals out in the open were closer to her than the bus so their stickers were next to the sticker depicting her – the cat with the umbrella is relatively far away from the bus. Effectively, Jasmine recreated that moment and how it felt waiting for the bus using stickers. Examples of illustrating self and an event were common. Another example involved the youth Destiny.

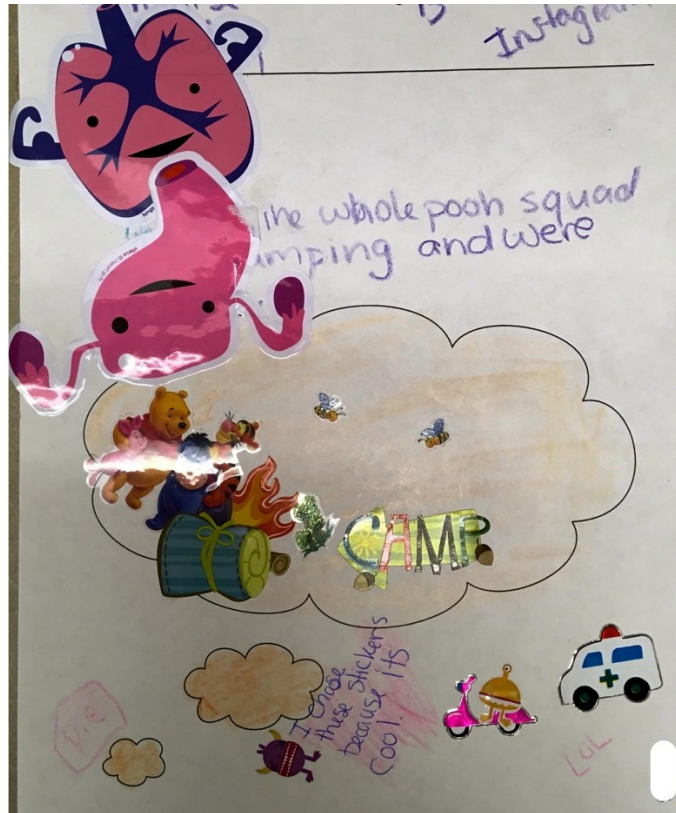


Figure 21: The youth Destiny combines stickers by overlaying them to create more complex ideas. The organ stickers represent a version of herself or her anatomy.

Destiny used a few different sticker packs – organs with faces pack, a monsters pack, and a Winnie-the-Pooh themed pack. When using these sticker packs she overlapped stickers of the same place to illustrate a larger concept. For instance, the Winnie-the-Pooh stickers connected the characters with a campfire to depict the concept of camping with friends. The monster pack was also used because she liked them, but they were noticeably distant from the friends camping stickers and were not connected. The organ stickers were also used and connected in a way similar to how they are positioned in a body – lungs above a uterus.

It should be noted that Destiny originally intended for all the stickers to be located in the thought bubble on the worksheet. A facilitator let her know she didn't have to put the stickers in that thought bubble if she couldn't fit everything.

557: Daniel You can put stickers outside of the bubble. It's fine.

558: Destiny But that doesn't look neat.

It is interesting that the illustration of a bubble on the paper was seen as so important for organizing her stickers. This is yet another type of overlap – the stickers are technically inside of the bubble. Destiny making efforts to fit the main friends camping concept in the thought bubble while she added the extra elements, she liked outside of it is an interesting illustration of how overlap can create associations.

These examples of stories illustrate how proximity is important for understanding the degree of connection between the idea the sticker conveys and the supporting contextual detail of the media or text it is near. The closer the sticker, including fully overlapping or being contained inside of another, the closer the association. This proximity rule also had some extra effects for using stickers where there would sometimes be clumps of stickers. That would indicate more units of information such as a sentence or paragraph or larger. The closeness of the sticker and how it overlaps other elements are important to understanding the grammar of stickers.

Narrative Structure: Using Stickers to Tell a Story. In this section I will look at one specific way to use the grammar of stickers. I will show examples of how stickers were used as a way to create or (re)tell a story. Many usages of stickers relied upon some form of narrative. Previous examples included a simple narrative (e.g., going to school). Some of the youths added words or lines to help guide the narrative. The youths essentially added supports to help a person read the stickers in the order they intended. There were many examples of relatively simple stories where a character performs an action. For instance, there is this example of fictional characters going camping.

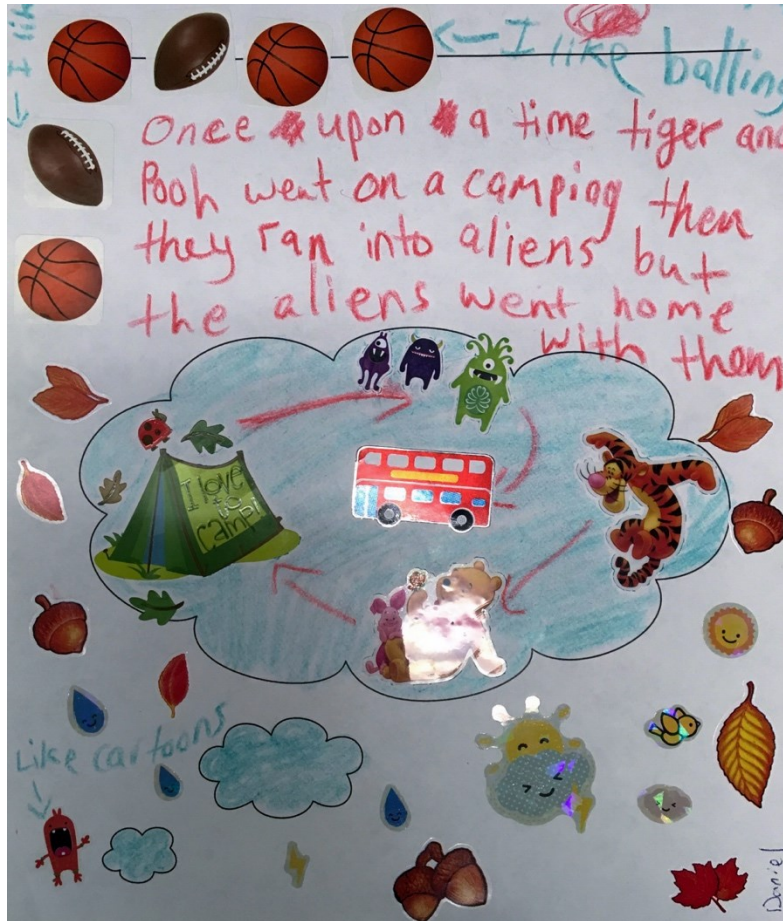


Figure 22: The youth Regina made a fictional narrative using stickers involving the characters Tigger and Pooh going camping. The narrative flow is directed by arrows they drew.

Regina added lines with arrows to depict how to read the story. Similar to Destiny, Regina's story involved Winnie-the-Pooh going camping with friends and meeting aliens. Instead of relying on proximity of the stickers to tell this story Regina added lines to provide an order of events. The friends went to a campsite, camped, met aliens, and then went home with the aliens.

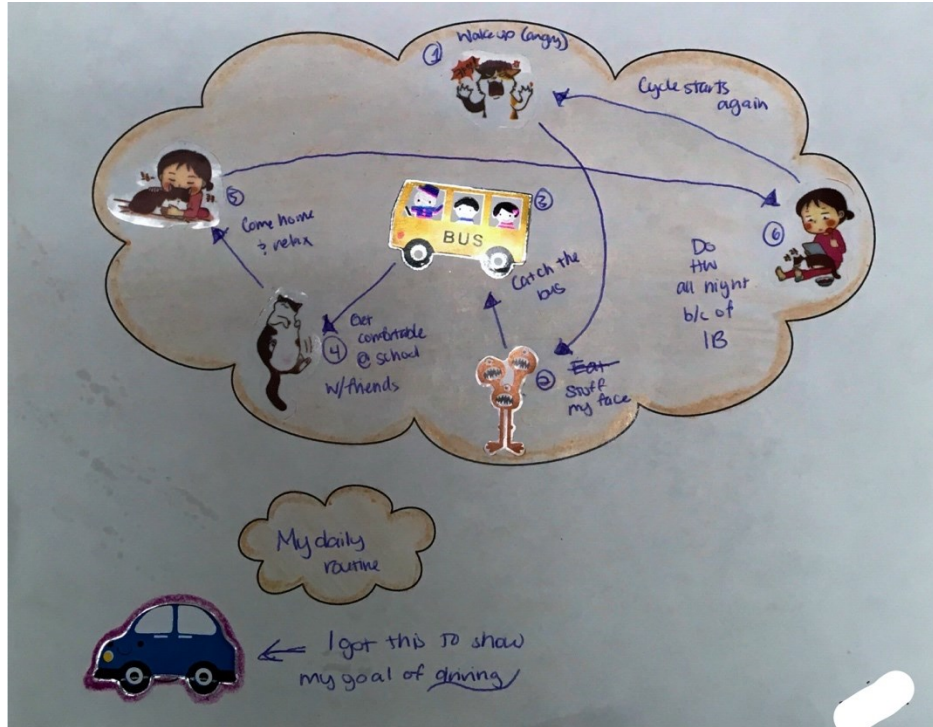


Figure 23: The youth Aurora retold a non-fictional event of going to school. This story is cyclical and follows the arrows. Each major event in the story is represented by a single sticker such as a sticker of a bus meaning “catching the bus”.

Aurora used arrows similarly but instead of telling a linear story she told a series of events that formed a cycle. This cycle was about her going to school each day and how she felt about those moments of her day. An angry cat depicts her before going to school. An arrow points to a monster to represent eating food quickly. Then an arrow to a school bus sticker represents going to school. And this continues until connecting back to having to wake up to go to school again.

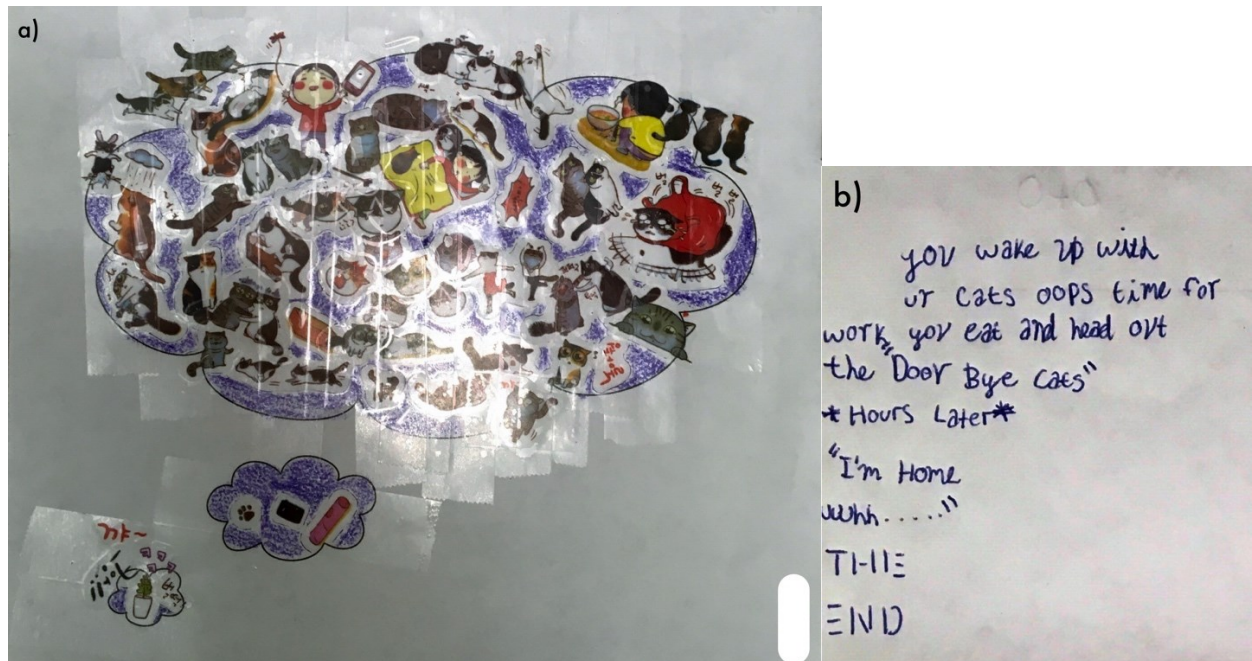


Figure 24: The youth Nova wrote a poem after using stickers to create a collage to illustrate her thoughts about visiting cats.

However, not all the stories included such linear narratives. Nova created a form of written poetry:

you wake up with

ur cats oops time for

work you eat and head out

the "door by cats"

* hours later *

"I'm home

uhh..."

THE

END

The stickers are then used to illustrate this kind of free flow idea of leaving their cats before heading to work and then coming back home to them. There is still a narrative, but it isn't presented as a step-by-step linear continuation. It is interesting that the text was more freeform as well.

These examples show how stickers can be used to not only illustrate linear narratives with a beginning, middle, and end but also used to describe other kinds of narratives. Placement proximity being an important part of organizing the ideas represented by sticker makes use of multiple dimensions. While written languages like English have a defined reading order in prose, stickers show elements of essentially the structure of poetry. This is a key difference between how English narrative structure differs from sticker narrative structure.

Discussion

Overall, during the *Story Design Session* the stickers were used in a variety of ways to communicate a range of ideas or stories. The stickers were often placed next to each other and sometimes were touching. Distance from each other represented the distance between the ideas. Some non-sticker scaffolding is useful to help contain the stickers whether it be the thought bubble that was on the piece of paper provided to them or drawing additional lines to connect ideas with arrows. Sometimes the ideas proceeded left to right but often the stickers were to be read in a unique order that had to be deciphered.

It is important to understand how stickers are used as vocabulary to communicate ideas and how those ideas are used together with a grammar to communicate more complex ideas.

Understanding stickers as having what I am calling vocabulary and grammar is important because of how my dissertation frames the everyday interest of youth. I am framing interest – whether it be about a video game, reality tv show, biology, or astronomy – through the lens of affinity spaces (Gee, 2005; Gee & Hayes, 2012). The interest is explored through a common, interest-driven space by a diversity of people. Language is not only used to communicate these interests but created to explore shared interests.

It has been understood that small groups of children do create their own languages to communicate (Bohn, Kachel, & Tomasello, 2019). As previously stated, people create jargon (not an entire language but elements of one) discussing concepts in affinity spaces (Gee, 2005). In a sense, language is not a strictly top down learned phenomenon with an expert defining terms and rules. Language can be a creation of everyday people communicating ideas in a way that fits their experiences. This is why language is important for affinity spaces. Thus, I will define how stickers can similarly have rules and definitions created by youths (and adults) who use them to communicate ideas. Better understanding of these use patterns provides us with design insights that can help design and explore how stickers can be used to communicate contextual details about interests that may not be as easily conveyed using the written or spoken word.

Vocabulary Insights. I first will discuss sticker use patterns in terms of insights from the data that help to define *sticker vocabulary* and then how they are used as part of a *sticker grammar*. These insights are useful for understanding how to better design the experience or technology around using stickers to help youths communicate their interests which I will detail as *design suggestions* for stickers in the final part of the discussion. The following are the main insights regarding how stickers can have vocabulary.

(1) Stickers representing an inanimate object tend to have less complex information about the subject being communicated.

The youths often used stickers of inanimate objects to provide contextual detail. For instance, several youths used a basketball to represent basketball the sport. Another example was using a drop of rain to represent raining. This wasn't always the case. Some inanimate objects were used to represent more complex concepts in association with other stickers. For instance, a syringe injecting a lamb with medicine or a school bus representing going to school and not just the concept of a school bus. I will discuss combining stickers more in the *grammar insights*.

(2) Stickers with personified traits tend to connect to ideas connected to people, and often to self.

Stickers that were personified (e.g., have eyes and a mouth on them) were often used when representing a person. These people were friendly themselves or friends. The specifics of the personified sticker were used to describe aspects of the person whether that be laziness (e.g., a napping cat) or some other personality trait. Providing information about a person can also happen through association, which I will cover in *grammar insights*.

(3) Describing an action (verb) often requires a personified sticker to be used somewhere. But having a personified sticker did not necessarily require an action to take place.

The stickers that were personified often implied some form of action (or inaction). The most common example of an action being taken in the stories was going somewhere – often to school or home. In this instance a sticker of a bus or other vehicle was used to indicate

transportation of a person. So rather than the sticker meaning a bus as a noun it was often being used to as a verb to be bussed somewhere.

However, this is not always the case. For instance, Jasmine used a bus sticker, but it literally meant a bus rather than the act of being bussed somewhere. The action was rather the act of waiting for the bus. As known in linguistic theory, words can have different definitions in different contexts (Gee, 2015a). It is important to understand patterns that may help discern when the bus sticker means the noun form of bus as a vehicle compared to when bus means to be transported somewhere.

Using where a youth placed the depiction of a person (or self) while using the stickers as a marker for the intended meaning of a sticker (or object) can potentially be a useful guidepost for understanding how to read the entire composition of sticker and connected objects (e.g., words or images). Understanding if a sticker represents a person is the first step towards understanding the patterns that I will go into in more detail in the following *grammar insights* section.

Grammar Insights. As indicated in *vocabulary insights*, stickers are used as part of a composition. This composition is created by the youths to produce meaning. I call the rules behind these sticker compositions a *sticker grammar*. Understanding the grammar of symbolic representations such as emoji have been shown as being more complex than simple sequencing of images (Cohn, Engelen, & Schilperoord, 2019). Roughly speaking, “correct” grammar (1) follows the rules and patterns created by the speaker and (2) human cognition allows some patterns and disallows other patterns (Gee, 2015a). It is my aim to start to plot out what these rules are, both affordances and constraints, for stickers when communicating ideas.

(1) Proximity of a sticker to an image or word usually indicates some level of proximity of the idea. The farther the distance between stickers, the more distant the idea.

The most basic pattern is the distance between the sticker and the rest of the composition. As previously described, proximity of the stickers to either other stickers or objects (either “real” or in a photo/image) conveys some connection. The farther away the less the connection between what the stickers represent – if there is a connection at all. These types of connections often are there to help describe the thing they are near. This was seen in examples in both RQ2 and in RQ1 with the Expressions Group (e.g., frowning face next to their head to convey unhappiness).

This connection was also apparent when they convey the narrative of a story. The closer the sticker the more likely it is to be “next” in the narrative. It should be noted that closeness of the sticker to what it is modifying seems to be more important than any other kind of organization. For instance, reading stickers left to right as is done in writing in English was in the minority in the examples from the *Story Design Session*.

(2) Stickers covering another object are usually some forms of editing of an idea. This can be merging or fully replacing an idea represented by the stickers.

When stickers start to actually touch or cover what they are being connected to the relationship changes. Touching or covering conveys a kind of merging or modification of ideas. Some kinds of the merging can be conveyed with simple proximity and not touching. Stickers overlapping though seems to mostly be used when merging or replacing ideas. This is an important constraint, since only the “top” sticker is immediately completely visible. What is underneath the sticker is not necessarily discernible and depends on how much the sticker is covering.

The covering of stickers can be either a synthesis of the ideas or complete replacement, depending on coverage. Synthesis is where the meaning behind the sticker and what it is touching merge to effectively become a new idea (e.g., friends plus campfire means camping with friends). Replacement is where the idea that is below the sticker is fully covered and thus replaced. The synthesis of ideas was the primary reason for stickers overlapping in the *Story Design Session* likely because it was a single person activity. Youths were not placing stickers on each other's stories. Co-work is where replacement as a form of editing is more likely to appear (and does, as I will cover in RQ3).

(3) Organization need not be linear. Other kinds of guided narrative structure, such as circular, were frequent. Also, there were examples of free flow association.

While much of the narrative structure in the *Story Design Session* was essentially linear, it is important to note that it does not need to be. Reading sticker compositions need not necessarily be linear (i.e., lacks this constraint). When the narrative was linear it often was organized not by the stickers but by additional guides such as arrows. Just as often though, proximity of stickers served as a guide for how to read the stickers. It was more similar to “reading” a piece of art than reading a text-based narrative. Indeed, the example of the youth who created a poem with stickers as illustration points to how stickers need not be limited to a simple linear narrative with a beginning, middle and end. Stickers can be used for that, as the examples that replaced words to create a sentence show. But it should be better understood how to explore a more proximity-based reading of ideas than a spatial ordering (i.e., left to right).

Design Suggestions. These insights into *sticker vocabulary* and *sticker grammar* are useful for considering the design of technology and activities that use stickers. In this section I

will detail a couple of design suggestions based upon the insights detailed above. Integrating these suggestions into future studies could lead to more insights for how stickers can be used to communicate ideas between youths and their parents.

(1) Need distinct art styles between packs to help differentiate complexity of the ideas that the stickers convey.

Sticker packs largely already have distinct art styles. This is valuable as it can help to differentiate the meaning (or vocabulary) of the sticker. For instance, where stickers from different packs were used together, they often served different parts of the sentence. A cat sticker pack can represent how the person feels sad while the cartoon bus represents them going to school and the raindrop represents the rainy weather outside. All three were from different sticker packs and were used to provide different information. The cat serves as the subject, the bus as the action, and the rain as the environmental context.

Using different art styles together, while potentially garish, can help intuitively guide the reader as to the purpose of each sticker. By sticking to using certain packs with specific art styles for specific types of meaning, the reader could eventually learn to narrow down the potential meaning of any new sticker from the pack that they encounter. If they know the cat stickers are people, any future or new cat sticker is likely to be assumed to be about a person and not a cat. Designing sticker usage to encourage this behavior will be important in helping to scaffold how to learn how to use stickers.

(2) A timeline of placement could assist with more freeform proximity association to give information about in what order the ideas might have been associated.

Another way to help guide reading could be based on understanding in what order the stickers were placed. One youth even explicitly numbered the stickers in order. Other examples that effectively do this include adding arrows to guide reading. Designs that have such rather overt reading orders could be used. But other potential ways to understand the ordering is to have an animation showing in what order the stickers were placed. This has the added benefit of showing any object that might be obscured by a sticker on top of it. Overall, there need to be more affordances that take advantage of how digital stickers are less permanently attached to an object than real physical stickers. For instance, making use of the ability to essentially “undo” placing a sticker could help with not only the readability of a composition (i.e., being able to see what a sticker is covering) but potentially help understand the order in which to read a composition by illustrating the order of placement. Knowing how the “speaker” placed the sticker provides clues for how to read the stickers by understanding the grammatical patterns and context of the “speaker”.

Summary

In this chapter I have described how youths can use stickers to create a vocabulary of meaning and then use those individual stickers together to tell stories or illustrate more complex ideas. While the methods are largely limited to physical stickers rather than digital stickers, they still provide some insight into how youths use stickers to communicate ideas.

The stickers were largely associated by proximity but didn’t necessarily require or involve the stickers touching each other. This is an important design consideration for digital stickers as often one might assume the stickers must be overlapping an object rather than only being placed near an object. Sticker packs are still important, but their importance turns more

into how to organize a vocabulary for meaning rather than being just a way to hold and distribute stickers.

The methods of RQ2 were focused on youths being the only ones to use stickers rather than being one party of many using stickers in the *Story Design Session*. I will go into interaction dynamics between multiple people using stickers in more detail as part of RQ3. I will use these patterns of *sticker vocabulary* and *grammar* to look at how stickers are used to communicate back and forth with another person in an informal science learning setting. These sticker insights help to better understand how stickers can be scaffolded for reading stickers. This scaffolding can potentially assist with more conversational communication that will be important for youths to discuss more fully their interests using stickers.

Chapter 7: RQ3 - Sticker and Interaction Dynamics

In the previous chapters I showed how children use stickers to illustrate interest as part of RQ1 and then how children used stickers to communicate with peers and adult facilitators as part of RQ2. In this chapter I focus on Research Question 3 (RQ3) and look at how real-world *interaction dynamics* between youth and parents in community settings impact *sticker usage*. In this section relating to RQ3, I will provide examples from an everyday-learning setting. This will include details about how both parents and children describe stickers, how they communicate with each other in their everyday contexts, and finally an example of how stickers can be implemented in an informal learning setting. The goal is to better understand how digital stickers can be integrated into already existing interaction dynamics between parent and child. The contributions from RQ3 will focus on how stickers can be integrated into already existing parental learning roles and ways to better understand the needs or motives behind youth using stickers to communicate with their parents. Overall, the goal is to better understand how stickers can be integrated into the interaction dynamics of a family.

Findings

As previously stated, RQ3 focuses on better understanding how stickers impact and are themselves impacted by the interaction dynamics between youth and parents that already exist in community settings. As with the previous research questions, the research context is the informal science learning community Science Everywhere. In this community I will specifically focus on three aspects to answer this question about stickers and the interaction dynamics between youth and their parents. (1) In the first section I will explore what motives or roles of parents influence

sticker usage with their children. (2) The second section will provide examples of how youth and parents' digital ecosystems and preferences influence their usage of and stated motives for using digital stickers. (3) And finally, the last section will provide an example of sticker usage being scaffolded in a community setting to illustrate strategies that youth and parents take up while using stickers.

In this findings section I will use a combination of artifact data from the Kitchen Chemistry session as well as descriptions of the artifacts from post interviews. The interviews also provide insight regarding how the participants felt about and see sticker usage in general or in specific settings such as at home. The goal of these findings is to illustrate and to better understand how stickers can be used in combination with already existing interaction dynamics including parental roles to help facilitate youth communicating their ideas.

Parental Roles and Motives for Learning. This section will detail how parents explain their motives and needs for supporting their child's learning. These details will include examples of how parents view their role in their child's learning as well as what community support they value for helping them to assist in that learning. While this is not immediately connected to sticker usage with their children it does provide important contextual information to understand what parents find important and valuable. These insights can then inform how stickers can be implemented to communicate important information between youth and their parents.

Specifically, this section shows details about the context of both youth and parents. Understanding the context is important to better describe the potential motives and modes of communication that could make use of stickers as well as any barriers that might appear to potentially make certain styles of sticker usage less optimal. These interviews explore their

thoughts in general about how and where they communicate learning and learning interests. Science Everywhere, as the informal learning context, was primarily seen as a community that helped to support science learning by both youth and their parents. However, the youth and their parents talked differently about how the community of Science Everywhere supported learning. Parents primarily focused on how they could help their children learn but they also pointed out that it is important that they understand how to support learning. The community providing a place for both youth and parents to engage and discuss science was described as valuable. The scaffolding that encouraged this was seen as so valuable that it was replicated by parents outside of the immediate place of Science Everywhere. Their children also took the practices of Science Everywhere into their everyday lives, but it didn't always reflect what their parents anticipated.

Parents want to understand so they can help. When looking at parental roles, a common theme arose from parents. When parents were asked about their child's learning they responded that they as parents want to know what their children learn outside of the home context. This means knowing not just what their children are learning in a general sense but having a specific day-to-day knowledge of the content and process behind the learning. For example, one parent, Luna, made some observations about what she viewed as important. Luna stressed how it was important to learn what her children do while she isn't there so she could help them work.

Interview 3:

6: Luna For me. I'm interested in whatever has helped me to help them to understand. You know, like when they first started Science Everywhere, to me it was really hard because I didn't know what was going on, what it was about, not until they were, and then they were talking about

process day to day. So, as a parent, I think I would like to learn, like, I mean be able to know what their day like, what they want to do, what they want to learn, so I could be able to work and help them.

Luna later implied that being able to attend Science Everywhere also helped her to understand her child better. She acknowledged that she didn't fully understand what happened at Science Everywhere and that she learned over time by talking with her children. She notes that the important part is that she needs to understand what her children are doing so she can help them. Interestingly, Luna framed this as working to help them which implies a parental role to support learning.

Parents want to learn synchronously. Another common theme with the parents is that when they were asked about their own learning, they would reframe it as them learning about their child. This learning often took on an active role where the parent had some amount of presence during the learning process. For instance, when Luna was asked about her learning interests, she explained the importance of supporting the learning of her children. Luna noted that it wasn't just learning what her children were doing but also engaging with the learning herself.

Interview 3:

10: Luna Yeah, well, just to be in the same spot with them. Like whatever they're in the process of learning, so I can actually be with them and know what they're actually doing more. I mean, because you know how social media is now, and there is a lot going on in there. So, when I'm there with them, I want to be able to understand what they are exactly doing.

An interesting distinction is how Luna also made a comparison between face-to-face and digital communication. She noted that there is “a lot going on in there” with respect to how much content is potentially in social media or other digital communication services. She contrasted this by saying she wants to be there in person so that she can understand what she might see in social media. She wants to understand what they’re doing in the moment which implies that the digital communication is more asynchronous than the face-to-face communication about what her children are doing and learning.

Parents value being there. Parents not only described how learning about their child was important but also how being involved was important. Being involved in the learning process seemed to require being physically there in the learning environment for some parents. For instance, Luna’s previous descriptions of being involved with her children actually went into how she valued being able to be there in Science Everywhere sessions. When asked to discuss her learning in more detail Luna explained that she did learn from going to school herself. But then she quickly added that she learns in different contexts. One of those contexts was Science Everywhere.

Interview 3:

58: Luna I would say that I learn, I work as a CAN, and I went to school for it, and I learned that. It was something that I thought I was never going to be able to make it.

59: Daniel So, you learned at school.

60: Luna I did that at school. I've been able to learn different stuff like at school, outside at, I would say at church. I have learned different things in there that I didn't know about it. I learned in the process when I was coming here sometimes with them, Science Everywhere. I got to learn that with them, because they were coming home and talking about it. I got the chance to listen to it. They were explaining it to me. So, I learned that way too, different things they were doing.

Luna pointed out that she learned the content from Science Everywhere alongside her children while she was at Science Everywhere. Being able to connect with what her children were talking to her about while attending the session is why Luna values Science Everywhere; it provides an environment and programmatic supports to learn alongside her children. In other words, being able to be present and understand the context of the learning her child was taking part in was seen as being valuable.

Parents take learning practices home. While previous examples showed how parents valued learning with their children during Science Everywhere there were also instances that showed the parent taking learning practices home. Learning practices being taken home from Science Everywhere is not surprising – the program encouraged ways for people to engage with science in their everyday lives. Science Everywhere was focused on supporting scientific disposition with young learners. However, it wasn't just scientific dispositions. Parents also talked about using specific practices they learned from Science Everywhere.

Interview 3:

70: Luna Then also like bake. I would have them, I would take lists, like notes about it what to do. Everybody wanted to do cupcakes. I offered to bake a cake, to do something different. They all just wanted to do cupcakes. So, things like that. I learned how to write down the amounts and everything for them. They're very little. They are 5, 6, and 7, but they're getting very good.

71: Daniel So, you're doing your own kitchen chemistry.

72: Luna Yeah, trying to do that.

In this example Luna talks about how she took the Kitchen Chemistry activity from Science Everywhere and brought it home. Instead of the program offering the question to explore while baking or cooking, Luna and her children made their own activity. She talked about measuring ingredients while cooking as an important part of a learning process. Luna described how she and her children started writing down specific details and taking notes while baking cupcakes that her children enjoy. This change in their communication practice shows how a program and community such as Science Everywhere can help to change the way parents and children communicate.

Science Everywhere helps youth make connections. Parents saw how their children were making connections with the wider community because of Science Everywhere even if they didn't share these experiences with others. However, the connections they anticipated did not necessarily appear as they expected and required discussion and understanding. For instance, Luna saw how her children, especially Aurora, talked about and shared what happened during Science Everywhere. Luna mentioned how the sharing was sometimes done using social media.

Specifically, Aurora would share pictures using social media platforms as well as using the dedicated Science Everywhere app. Aurora was using these technologies not just during Science Everywhere but also to share her science learning in her everyday life.

Interview 3:

5: Daniel Okay, so, you think about like the right place, it's just different. Okay. So, what is one thing you learned from Aurora, Celio, or Nova that you learned from them via social messaging or like in text messaging or social media?

102: Luna From social media, the only thing, because Nova was the one who was sharing with me. She would like take pictures of places and the most amazing places. That's what she was calling it and most interesting places also. She was taking pictures and sharing on the same app that Science Everywhere had before. She was always talking about when she was taking a picture. I'm like, why don't you just take a picture of anything? She would pick some stuff, and she was like, no, because this doesn't have anything to do with Science Everywhere. She was talking more about being nice and clean. How clean it is. How nice it is when you go to the recreations, like any park, and you see everybody is taking care of the park because it's for all of us to use, and we to maintain the place clean. It has to be safe for everybody. So, she'll be taking pictures of those places. That was the most thing she was sharing about. When we were going to the beach, she would find some people would throw

trash or plastic stuff in there. She was like, this is gross. This shouldn't be happening. You know, we're killing the animals. We're killing the fish. I'm like, I know that was something that we didn't talk about. She was like, Science Everywhere is like, you know, everything about science, but you know, everything about where you live around and what is safe, and clean, and what you should do and what you can't do, what you should not be doing. So, she was more specific about all of that.

Interestingly, most of the discussion was implied to be one-way, where Aurora would share images and Luna would learn what Aurora was doing. There wasn't as much discussion about a back-and-forth conversation happening solely in social media. Aurora discussing her learning, such as how plastic is gross because it is killing fish, was done face-to-face. So, the conversation around the Science Everywhere activities seemed to take place using a variety of mediums – face-to-face at home, social media, and the Science Everywhere space.

Children value opportunities to explore ideas. These examples show how the parents appreciate the connections they gain from programs such as Science Everywhere and how those programs impact their communication with their child. This brings up the question of what their children value from a community or space like Science Everywhere. The children often expressed how they appreciated how they could explore their own ideas. The children valued the community giving them an almost open forum to talk about their ideas. For instance, Aurora approaches this concept of an open forum where she can decide what she wants to talk about by talking about an after-school program.

INTERVIEW 2:

25: Daniel [...] You've said you do this at school usually for face to face interactions. Do you ever like meet up with them anywhere else?

26: Aurora I don't meet up with them to talk about psychology only, but I do meet up with them sometimes, and that subject has come into our conversation. It's mostly at school we talk about psychology. Like that's the main topic of our conversations.

In this instance, the school provides a space to discuss the subject. Aurora doesn't take the conversation outside of that space though. So, it is more than just being face-to-face but also that there is something about either the program or the content which results in Aurora not continuing the conversation elsewhere.

Aurora then expanded her description of how she converses in spaces by talking about a program that she attends at a local church. This Young World program is described as being almost an open forum where the participants can discuss "anything we want to learn more about".

Interview 2:

28: Aurora There's a program called Young World here at Solid Rock Church where we talk about society and the interactions with people whether it be like race or like things, policies about guns, stuff like that. Anything we want to learn more about and what we have opinions about. We

come and we meet, I think it's like every second Friday of the month and discuss whatever we feel like we need to bring up.

29: Daniel So, who is part of this group? Is it like older people or people your age?

30: Aurora It's called Young World because it's mostly people, it's mostly teenagers and some adults. It's Mr. Teller, a couple of other adults here at the church as well, and I have several friends that go there too.

Aurora seems to value having an open forum where she can discuss ideas with peers face-to-face that they both have opinions about. Having a space to freely explore ideas is valuable but she again does not describe taking that structure elsewhere. Both times she talked about how she enjoys talking about philosophy and politics but limits them to a very specific physical space. Both times it was purely face-to-face as well, and she did not discuss any other ways of sharing these topics. Political or philosophical subject matter being able to take advantage of similar scaffolds as Science Everywhere did for science is a potential area for further exploration.

Digital Communities, Spaces, and Stickers. In the previous section I showed examples of what parents valued from informal learning spaces and communities. This provided necessary contextual detail to understand how parents approach communicating with their children regarding their learning interests. In this section I will now look at how youth and parents' digital ecosystems and preferences influence their motives for using digital stickers. These examples of how youth and parents share in digital spaces provide important contextual detail about how they view sharing and communicating ideas around learning interests.

This section is composed of two subsections that detail examples from interviews with youth and their parents. The first subsection will focus on the digital community and spaces as well as the communication technology used by both. The second subsection will explore how stickers are currently used in those spaces as well as what youth and parents think about this usage, including any benefits or potential limitation that they see as impacting how they and other people use stickers with them. These two sections will provide contextual detail about how stickers are and can be implemented within the already existing interaction dynamics between youth and parents.

Youth, Parents, and Digital Sharing. As alluded to in the previous section describing the community context, facilitating sharing between youth and their parents is an important aspect for supporting learning. In this first subsection I will detail youth communicating differently with their parents compared to peer groups and how that is reflected in the various digital spaces the youth and parents are part of.

For instance, youth were more likely to communicate using images with their peers than with their parents. Children also tended to talk with parents more about logistical details such as needing materials or needing transportation than about the underlying interest behind an activity. That is not to say youth communicating with their parents is framed as being restricted compared to with peers. Youth also used digital communication when they wanted to talk to their parent privately. Youth seemed to describe that there were requirements for talking with their parents but that they also could see ways that might reduce those requirements, such as by using stickers.

Children want to share Science Everywhere. When discussing how the Science Everywhere community supports learning, one of the things that came up was how the children

wanted to share with their peers. The parents noticed this desire from their children to share Science Everywhere with friends and extended family members. The desire to share wasn't so much focusing on content such as photos from a Science Everywhere activity. Rather the children wanted to share the entire Science Everywhere experience. Luna explained how her children wanted to bring essentially everyone they knew to Science Everywhere.

Interview 3:

45: Daniel So, they shared what they did at Science Everywhere with you and their cousins and things like that and then at the symposium. Was there anyone else that you saw they shared what they were learning in Science Everywhere?

46: Luna With their friends, my friends' kids, and my sister's kids. At some point, they wanted to bring all of the kids in here.

The idea of a physical place and time being important comes out throughout the interviews. Even when there is digital communication, the physical context and situation impacts their choice of how they tend to communicate digitally with different people. I will go into this in more detail.

Children text parents but do not contact on social media. Sharing being dependent on the community or audience is something that was also brought up with respect to digital communities or spaces. These spaces are often defined by the platform, such as Snapchat or Instagram. These platforms usually have an implicit audience. For instance, youth participants often described a scenario where their parents were only on a small selection of the platforms the

child was on or even potentially none at all. Overall, the children tended to communicate with their parents with text through SMS messages or the platform iMessage.

For a specific example, one youth, Isabel, discussed how she used the platform Snapchat. Isabel explains that she likes to share pictures with her friends such as memes or other images on Snapchat. In this context, sharing images seems to be primarily for entertainment to express humor.

Interview 1:

52: Isabel Yeah, like we send each other like pictures, like memes.

53: Daniel Yeah. So, what do you think when they share a lot of those images?

54: Isabel I laugh at them.

55: Daniel You laugh at them. They're funny?

56: Isabel Yeah.

However, Isabel explains that she doesn't send images to her parents using Snapchat. She further clarifies that she only sends text messages to her parents. Isabel doesn't explain any limitations about why she doesn't share images with her parents over Snapchat.

Interview 1:

57: Daniel You didn't say your parents. So, you don't talk to your parents on
Snapchat, right?

58: Isabel No.

59: Daniel So, do you do any sort of communication with your parents that are like Snapchat, or is it like completely different?

60: Isabel Text message.

61: Daniel So, you just use text messages.

62: Isabel Yeah.

Essentially, parents and children are not fully overlapping when it comes to digital spaces. The main area of overlap is text messages but that usually is more text focused – hence the name. That isn't to say they do not share images between each other, but it does point out the way the children think about sharing with their parents as being more limited to a specific digital space especially when compared to how the youth share with friends.

Communication with peers, logistics with parents. As the previous example showed, the youth were more likely to use images when communicating with peers compared to with parents. Additionally, youth were more likely to use text and stick to discussing logistical details rather than the underlying interests with parents, even going as far as delaying communication until the last minute to prioritize parents discussing logistics. This means the communication tended to be focused on specific goals for things like materials or transportation rather than being about more abstract concepts. Essentially, there was less talking about “fun” and interests and more talking about specific perceived needs.

In one instance this difference was described as talking with friends is about “normal things” where talking to parents is about transportation needs. In this instance the youth in

question, Jasmine, preferred to keep her digital communication with her parents to logistical details through text messaging.

Interview 1:

59: Daniel So, your parents send you those things, but you don't. You just text.

60: Jasmine Yeah.

61: Daniel Okay. Is there like a difference in content in what you're talking about then?

62: Jasmine With my friends we talk about the normal things. With my parents it's either like, I'm picking you up now, or like I asked them like am I supposed to go to the dentist today. Like things like that.

Another child, Juliet, went further and explained that she intentionally communicated at specific times with her parents digitally. In this example Juliet explains how she communicates just in time with her parents after she already made plans with her friends. The reasoning behind this is related to how her parents were not present when the plans were being made. Communicating the full details with the parents was implied to be overly burdensome because the amount of communication between parent and child was described as being low anyway.

Interview 3:

75: Daniel Okay. How is it different between your parents and your friends, texting?

76: Juliet Because my parents, like they're not ... like, not at school. Stuff that happens at school, I like to talk with my friends, get their opinions on it.

I sometimes like to make plans with my friends. I make plans with my friends before I tell my parents. Then after I tell my parents, and because me and my parents, we don't talk much. We don't talk a lot, and me and my friends talk a lot.

This description of how Juliet communicates her plans with her parents paints a picture of their being intent not just with what is being communicated but when information is being communicated. Juliet has a specific communication style over text message with her parents. Furthermore, the way the children described their interactions with parents implied there was some inertia around how they are communicating with their parents by text. In other words, the specific reasons for the children sticking to text only could be important for understanding why stickers may or may not work with an already existing interaction dynamic and should be accounted for when planning implementations that use stickers.

Texting provides privacy. While I shared how youths might avoid communicating it is important to also understand why they do communicate in certain ways digitally. One factor that youth brought up when explaining why they might communicate digitally is the concept of privacy. Youth sometimes used or didn't use text to communicate with their parents when they wanted information to be private. Digital communication offers different ways for information to be shared privately.

For instance, Isabel described how privacy was a reason why she would text something to her parent when they're both at the same place. Isabel explained that she used text in those situations to avoid being overheard, that she used text to send something she wanted to be private between her and her parent.

Interview 2:

25: Daniel Talking with your parents, what are the kind of things you're talking about with your mom for instance, in general?

26: Isabel With my mom I usually talk to her about making plans and stuff like that. So, I don't really use stickers or anything like that. Sometimes I like say a joke to her, but that's it.

27: Daniel So, is it like the joke is written out in text?

28: Isabel Yeah like, no like sometimes if we're in the same place, and I want to tell her something, like oh, did you see what she's wearing, or something like that, then I'll text it to her so that nobody else can hear us.

This description of using digital messaging at a face-to-face event adds some interesting context to their communication. While the predominant interaction between Isabel and her mother using text messaging is more logistical, details like providing transportation, there are other use-cases that might be overlooked. These use-cases could be where stickers or images in general might be useful while communicating. The example use of text messages to relay private information is an important piece of context for understanding why youth communicate with the parents at certain times in certain ways.

Appropriateness and norms while communicating. With these examples of why youth communicate digitally with their parents there is the question of why they don't communicate more like they do with peers. Understanding the differences between communicating with peers vs parents is necessary to understand how youth think about communicating with their parents in

general. This is a somewhat complicated idea about why you might talk to friends differently when compared to parents. One youth somewhat succinctly described the difference in terms of the concept of appropriateness. When asked specifically why she wouldn't use images or stickers with her parents, Aurora explained by bringing up this idea of appropriateness. Aurora started by explaining how you are more likely to understand your peer group. So, teenagers understand teenagers and parents understand parents.

Interview 2:

65: Daniel Pretending that you were doing this with adults or parents or people that are older, how would it be different, do you think?

66: Aurora I feel like as a teenager you relate more to teenagers, and you're not afraid of them seeing anything, well, not speaking personally, because I don't do those things, but I know people who would post things they shouldn't be doing. If it was with adults, they wouldn't be posting any of that at all.

This moved on to Aurora explaining that she would be self-conscious about posting things that she shares with her peers such as selfies. She expressed this as being worried about if something was appropriate to share with her parents.

Interview 2:

70: Aurora No, it's fine. I think that I would ... I don't know, maybe not as much selfies. I would be a little bit self-conscious of like adults seeing me. Posting family like when my family is meeting together, us playing

around with family members, I would still continue to post that. I feel like I would change just the things about myself, posting myself on there.

Aurora was then asked to think about communicating without having to worry about appropriateness. In a “perfect world” where she could share without this concern, Aurora explained that she would like to discuss what she does already, just do more of it. That she likes to talk about working and helping in a community and that she would like for that kind of communication to be easier.

Interview 2:

71: Daniel Okay. In that perfect world, what would you like to talk to them about, your parents or other adults?

72: Aurora In a perfect world?

73: Daniel Yeah, sort of like in a perfect world what would you like to talk to them about on Snapchat?

74: Aurora I think just anything that interests me, because I do have a wide variety of things that interest me. It’s not just like social issues, it’s more like you know, just discussing, oh, well what can we do to help people in our community, stuff like that. Just like in a perfect world it’d be easier to talk to people have the ability to help you make a change.

This description details that there are some norms, perceived or otherwise, that impact youth feeling like they can communicate about interests in a way more similar to how they share

with peers. What is essentially being communicated by youth is that it is important for those who implement stickers to be aware of communication norms. Implementations should avoid assuming a “perfect world” that the youth may not feel comfortable with and instead find ways to work within the interaction dynamics. Aurora is not against changing the norms but likely needs to be informed of such changes to help her communicate her ideas more easily.

Sharing with Stickers. In this subsection I look at how stickers, in particular digital stickers, are described by the youth and parents inside of the various digital spaces they are part of. These include thoughts about stickers as well as retellings of examples when they used stickers. For this subsection I will look at excerpts from interviews with a set of focal participants, including both youth and their parents. While previously in RQ1 I described how stickers can be used to illustrate interest I will be looking at how stickers are thought of by youth and their parents with respect to already existing interaction dynamics. This section primarily will show examples of how both youth and parents described ways for them to acquire a vocabulary of stickers including how they understand the meaning of the stickers used by other people.

Stickers can have ambiguous meaning. With this understanding of how parents and children communicate digitally, the question then is what role stickers play in the specific context and how do the youth and their parents see stickers potentially being used. One common observation about stickers was that it can sometimes be difficult to convey a specific meaning while using stickers. One of the primary observations was that stickers could have multiple different meanings. Sierra and her two daughters Jasmine and Sabrina agreed in this regard that

stickers could have many different meanings. Sierra expanded upon the idea that stickers essentially encoded information.

Interview 3:

- 110: Sierra Yeah, I think as I mentioned earlier, we need to, how could I put it?
Because they are like a code, you know. It's not you see them, and they mean something.
- 111: Daniel Yeah.
- 112: Sierra So, I need to know which one means what to Jasmine, which one means what to Sabrina.
- 113: Daniel So, you need to have like ...
- 114: Sierra Yeah.
- 115: Daniel And that's another good point you have right there is that just because it means one thing to one person, doesn't mean it means the same to the other one.
- 116: Sierra Exactly, exactly.

Narrowing sticker usage communicates consistent meaning. It also wasn't just that there were many ideas a sticker could convey but that there were many different stickers that could convey essentially the same idea. For long-term usage Sierra explained that there would need to be some way to make the sticker usage more predictable or consistent. How to scaffold using stickers requires some consistency by using the same sticker. So not only would when to use stickers be guided but also the variety of stickers should be limited during adoption.

Interview 3:

120: Sierra Yes, and then they're communicating with the same sticker. Which I mean, if each time I have to express my fear I use 10 different ones, maybe I won't know at the end which one what is the feeling there.

121: Daniel So, keep it sort of like limited to a certain amount.

122: Sierra Yeah, at least at the beginning. Then coming up with more maybe.

“Precise” stickers can narrow meaning. Overall, there being many stickers that convey the same idea or a sticker being able to convey multiple ideas was summarized by one parent as stickers lacking the ability to be “precise”. Kalani described how stickers were difficult to understand at times because of this lack of precision. However, one way Kalani and her daughter alleviated this was by using a more limited selection of stickers.

Interview 3:

183: Daniel Okay. So, the next big ... Do you have any thoughts or opinions about how you could use stickers to communicate more with Naomi in the future?

184: Kalani I want it to be more precise, you know? Straight to the point, because sometimes the interpretation of the one that she posts, like the sticker that is posted, it's not really ...

185: Daniel So, does she use like a lot of different stickers, or just a few?

186: Kalani Just a few, just a few.

187: Daniel So, she doesn't have a huge selection of stickers she ever uses with you.

188: Kalani Yeah.

189: Daniel But you want it to be more precise.

190: Kalani Straight to the point. Yeah. Straight to the point.

Precise or "straight to the point" stickers are described as being easy to interpret. She points out that by using these stickers it helps her to communicate with her daughter. As I will go into more in the Sticker Use Strategies section of this chapter, the two tended to use stickers with a single meaning such as yes or no. Kalani also pointed out that there were few of these precise stickers during the exercise. This comment about the lack of stickers was likely referring to how there weren't many stickers that could communicate the ideas required for the shopping trip exercise and were mostly limited to affirmatives or negatives. Expanding the range of precise idea stickers rather than having several affirmative and negative stickers could be useful.

Children want clarity from adults. Never-the-less, parents and children still do use these image-based ways of communicating. Both parents and children described how they would use emojis – even when one questions why the other was using the emoji. For instance, one parent, Luna, described that she used emojis to communicate sometimes when text would have worked. This resulted in some pushback from her daughter but there was still a utility for using this less precise way of communicating visually.

Interview 3:

144: Luna Nova would be questioning me. Aurora doesn't ask me more, but Nova does. She would be like, why are you using emojis? Why are you using

that? Why don't you just text me? sometimes I would be answering her with emojis. She would be like, where did you learn that.

A picture is worth 1000 words. Understanding what stickers might be used to communicate is important because of the utility of stickers when communicating. Compared to communicating by the spoken word or by text, the youth often described stickers as communicating more abstract ideas that might be hard to describe otherwise. For instance, one way to see stickers is that they are pieces of art that help you to convey personal needs. Naomi described stickers as being similar to emoji, that act as art that helps you express emotions.

Interview 1:

75: Daniel What do you think a sticker is?

76: Naomi Oh, a sticker is like something like a way to express yourself in art form.

77: Daniel Okay. So, what about a digital sticker?

78: Naomi It's basically like another emoji, but it would be more personalized, I guess.

79: Daniel Okay, so like a wider selection.

80: Naomi Yeah.

81: Daniel So how would you then use a digital sticker?

82: Naomi So, say if I need help on homework with something. It'd be like a pretty please kind of sticker.

[...]

88: Naomi Like if someone says something funny, or when I need to get your attention if you're not replying, and I need to talk to you or something.

What is interesting is that when asked about how to use stickers Naomi gave an example about asking for help. While Naomi didn't explain what she might be seeking help with, she did give a description of how she would ask for help. The sticker would be roughly translated as "pretty please". Another example was to use stickers to get someone's attention.

How rather than why. Overall, when the youth described events where stickers were actually used though, they tended to describe the method of using stickers rather than why it engaged them with the conversation. For instance, Isabel went into detail explaining how she uses stickers with her mom to express herself and how it is fun to see what sticker her mom uses in reply.

Interview 2:

73: Daniel So, have you used stickers with your mom?

74: Isabel She puts stickers on my like text messages, and like I use it sometimes with her when like if she sends an image. Then I'll be like, I'll put like a sticker on top of it.

75: Daniel So, you just sort of like will relay stickers on top of each other.

76: Isabel Yeah.

77: Daniel Is there anything you would change about how these interactions are happening, about how you're using stickers with your mom?

- 78: Isabel With my mom, no not really. It's kind of fun to see like what sticker she would send next like after I put a sticker down, and like if she sends a sticker like back. Yeah.

When asked how this kind of interaction might translate into the real-world Isabel more or less ported the concept over to the physical setting. Instead of placing stickers in surprising ways to express herself on images she would place stickers on her mom or herself to connect with her ability to express herself with her mom.

Interview 2:

- 81: Daniel So, these exchanges you have with your mom, the stickers, what would happen for instance if you both had like real life stickers that you'd give to each other? How would you think that would work?
- 82: Isabel Then we'd just be like putting stickers on each other.
- 83: Daniel Like on each other's bodies?
- 84: Isabel Yeah. Like if I put like, I don't know like a heart sticker on her forehead, and she would put like a heart breaking on my arm or something like that.

Digital stickers are less risky. The youth and parents discussing how stickers could be used physically vs digitally leads to the question of why we don't see usage of stickers in more contexts. If youth use digital stickers to add stickers to photos of their mom and they thought they would add physical stickers to their mom in real life, why might they not be doing this? One reason described was the concept of appropriateness. Specifically, the youth Naomi described

how digital stickers are providing a new tool for reducing the risk of communicating with stickers. Essentially, digital stickers are potentially less permanent than a physical sticker that can be difficult to remove.

Interview 3:

94: Naomi A sticker is something you stick onto something that's like tangible, and you can't like, remove it. Well, you could.

95: Daniel But it's hard?

96: Naomi Yeah, it's hard. A digital sticker is like you could place it anywhere, and there's no repercussions.

[...]

99: Daniel Okay. Can you? Do you? Do you do anything you want with digital stickers?

100: Naomi You can place it anywhere.

In this example Naomi is mostly discussing how digital stickers are different from physical stickers. Similar to how talking aloud reduces privacy compared to texting digitally, using digital stickers reduced the repercussions of placing a sticker on something when compared to placing a real physical sticker. For instance, while there may be consequences for placing a physical sticker on something, Naomi described how there would likely be no consequences for placing a digital sticker on an image of the same thing. The idea that you can place a digital sticker “anywhere” without potentially getting in trouble unlike with a physical sticker is an important difference between the two. This seems to imply a possibility for stickers

being framed or explained as a way to minimize repercussions of communication to encourage adoption and communication.

Similar to how Isabel explained that she sometimes used text instead of speaking face-to-face to keep a conversation private, Naomi explained that stickers could reduce “repercussions”. While the privacy concern was framed as being communication through digital text, there were some descriptions of why youth would share using digital stickers. Just like how texting reduces the risk of private information being shared, stickers can also reduce the risks of communicating. In this instance, stickers were described as reducing “repercussions” when discussing with parents.

Stickers can increase interest. Another aspect of using stickers to communicate is related to the ability to express interest. One example explained how stickers could not only show or illustrate an interest but could actually increase the interest level of a conversation. Jasmine explained how when she saw stickers being used it increased the interest level of the conversation overall. Jasmine commented that she could see becoming comfortable with using stickers over time because of this utility of stickers.

Interview 3:

109: Jasmine It would be normal, I guess, because my mom already uses like emojis. When she texts, she’ll use emojis. So, I feel like it would just be normal if she used stickers. I feel like it would be, instead of an ordinary conversation, I feel like it would make the conversation more interesting. Like, oh, I’m going to the store, and she puts like a food sticker, something like that. Yeah.

Jasmine explained that while stickers may not represent all of the idea being communicated, they have an ability to potentially increase the interest around what is being communicated. It is implied that a routine trip to the store could be potentially made more interesting by adding a sticker to the statement of going to the store. The sticker wasn't describing an interest itself but rather the stickers added the property of making a conversation of going to the store "more interesting".

Youth can be skeptical about parents using stickers. Finally, youth also discussed why they thought their parents might want to use stickers. From the point of view of one of the children, Juliet, she explained how her parents might want to use stickers to be "hip". Juliet seemed to be somewhat skeptical of the ability of her parents to become hip using stickers but was open to their usage just like how her parents started to commonly use emoji, even though she also considered that to be not cool.

Interview 3:

- 207: Daniel What's weird about your parents using stickers?
- 208: Juliet Because like, sometimes they try to be hip.
- 209: Daniel They try to be hip. Do you think they'd be trying to hard?
- 210: Juliet Sometimes.
- 211: Daniel Sometimes?
- 212: Juliet Yeah.
- 213: Daniel That's okay. So, you want your parents to be boring?

214: Juliet Not boring, but like just not ... just ...

215: Daniel Is it okay if they use emoji?

216: Juliet Yeah, they use emojis, and it's cool.

Still, this points to how stickers or things like stickers are being used by parents to try to connect to their children. Additionally, the children recognize what the parents are doing – even if they do not think the parents are succeeding.

Sticker Use Strategies. Finally, I will provide data from a practical example of sticker usage in Science Everywhere with both youth and parents present. I will provide examples of two different types of strategies both youth and parents used to guide their sticker usage, including how they explored and interpreted the meanings being communicated with digital stickers. This sticker was presented in a way to help facilitate serendipitous moments of communication between youth and their parent rather than being purely mandated. The sticker usage is semi-scaffolded for part of the session to encourage but not mandate usage of stickers as a way to introduce stickers into the community context. This is a practical application of stickers in context to see how they fit with the already existing and previously described interaction dynamics between parent and child.

For this section I will look at two family groups to describe two different ways to use stickers. It is important to understand how stickers are used in an everyday or informal science learning setting. There are potential contextual differences when it comes to using stickers in an informal science learning context compared to at home. One important factor is that in this context groups were determined by family unit – children were paired with a parent. These

setting and audience details are important when it comes to understanding how stickers were used to communicate.

The two family groups I will discuss exemplify two ways of using stickers. The first way to use stickers focuses on Clear Visual Communication, while the second way emphasizes Playful Co-learning. These styles, while distinct, do not exclude a family from using both at different times. However, as described in the interviews, the participants usually described a sticker usage as one or the other, not both. Both styles of usage were actually seen in different family groups. For ease of illustrating these styles I will focus on one family for each style below. The data uses screenshots from the digital communication to show the sticker usage and post interviews to help explain the meaning behind the sticker usage as described not only by the participant but by the other family members as well.

Clear Visual Communication. During the Kitchen Chemistry session, it was explained that families would be using digital stickers to communicate on the iMessage platform. Since the session framed the stickers as a means of communication, one of the ways parents and children used stickers was to talk with one another about Kitchen Chemistry. One way there was some differentiation between families was how some family groups focused the communication more on the tasks presented as part of Kitchen Chemistry. For this family group I refer to their requirement as a need for clear visual communication. Clear means that the usage of the stickers is primarily used to communicate a narrow set of information about the task at hand, with an easy-to-understand meaning. In the case of Kitchen Chemistry, the narrow meaning was related to conversing about which ingredients to choose from the available options.

The example family showcased this focus while using stickers to communicate clear information about the task. This family group consisted of Kalani and her daughter, Naomi. The family group mostly focused on communicating in an iMessage thread about the specific task of negotiating ingredients. Most of the thread involved Kalani posting photos of the ingredients and Naomi using a combination of stickers and images to respond. An interesting detail of the sticker usage is that stickers were frequently used in-line and not on top of the photos.



Figure 25: A sticker depicting hands (from a cat) grabbing butter with a heart sticker to indicate the youth likes it. Also, a sticker below is used inline with the text that has a butter pun.

Interview 3:

- 152: Naomi The heart, oh, I was trying to like with the heart and the hands, like cat hands thing, I was trying to emphasize that we needed the cream cheese.
- 153: Daniel Okay, so you wanted the cream cheese that's right there and not necessarily the butter.

- 154: Naomi Oh, yeah, and I said ...
- 155: Daniel And the butter too.
- 156: Naomi And, I said the yes, cat thing.
- 157: Daniel So, you were trying to say you wanted both of those.
- 158: Naomi Mm-hm.

When looking at the conversation from the other side, Kalani understood what Naomi was telling her using the combination of stickers and images. The hands clapping on top of the image with butter, but not directly on top of the butter, meant she was “pointing” to get the butter.

Interview 3:

- 156: Kalani Oh, I was taking a picture about what are the ingredients that’s available there. It seems like she’s pointing to that one to get it.

[...]

- 159: Daniel So, she was pointing at the butter?
- 160: Kalani Yeah.
- 161: Daniel Okay, and then that was sort of similar, getting the butter?
- 162: Kalani Yeah, to get the butter.

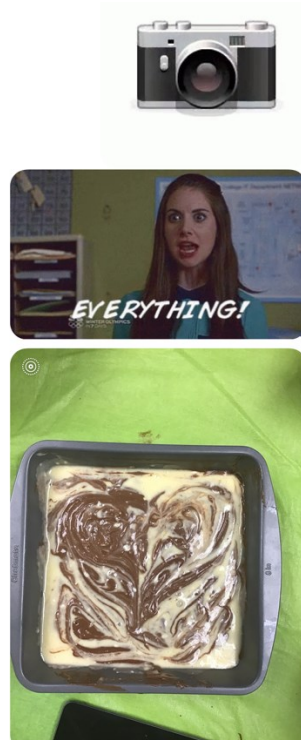


Figure 26: An image of a camera along with an animated gif where a person is saying “Everything!” is used by the youth to tell their parent to take photos of all the ingredients.

Naomi also used images to communicate and not just stickers. For instance, Naomi used a meme gif that used the word “everything” in combination with a sticker depicting a camera. Naomi used this meme to convey that she wanted photos of more ingredients. In other words, she wanted photos of “everything”.

Interview 3:

176: Naomi The next one after that, one more. Yeah. So, I sent the camera and everything, because I wanted her to take a picture of everything just in case we were missing any ingredients.

177: Daniel Oh, okay, so you wanted to have more information because she only sent just a limited amount of information.

178: Naomi Yeah.

Kalani understood this combination of stickers and image and successfully synthesized meaning. However, she had already started to return with the ingredients that the two initially picked out so she could not complete Naomi's request to take more photos.

Interview 3:

175: Daniel So, you were saying that you went ahead and got the cream cheese.
 Okay.

176: Kalani Yeah, the cream cheese. Then she said take a picture, but I didn't, of
 everything. Take a picture of everything.

177: Daniel But you were already on your way back, right?

178: Kalani Yes.



Figure 27: The youth used a sticker of a dinosaur with question marks inline to communicate that they are confused why there were not more photos of ingredients after the parent thought they “nailed it!” with their selection of ingredients.

Kalani was also able to understand when Naomi was making queries and not just statements after the fact. For instance, when Naomi was waiting for more images (not realizing her mother was returning with the cream cheese at the time and not looking at the messages), she posted a sticker of a confused dinosaur with question marks over its head. Afterwards, in the interview Kalani explained that the dinosaur was asking a question.

Interview 3:

170: Kalani She’s asking why.

171: Daniel What’s going on?

172: Kalani Yeah, like a question.

Unfortunately, it was not clear what the query actually was about. This points to how the lack of clarity when communicating with just images and stickers can lead to some confusion about what the message is. In particular, it can be confusing identifying who is talking. This exchange between Kalani and Naomi about the dinosaur actually caused confusion when discussing what happened later. When we discussed the confused dinosaur sticker, initially Naomi wasn't sure who sent the sticker. This was likely due to the "Yes" and "Nailed it" stickers immediately preceding the dinosaur sticker resulting in an unclear archival record of what happened. Naomi at first thought she said "Yes" and "Nailed it" while her mother used the confused dinosaur sticker.

Interview 3:

159: Daniel Okay. Then you didn't really add anything to those ones except for ...

160: Naomi My mom sent that.

161: Daniel Your mom sent that.

162: Naomi Yeah.

163: Daniel So, you sent that.

164: Naomi Wait, no, I think I sent these ones, and she sent that one. I'm not sure.

165: Daniel Yeah, I think you sent that one, and she sent those, because the left side
is her, right side is you.

166: Naomi Yeah.

167: Daniel So, you were confused, or why did you have this dinosaur?

168: Naomi Yeah, I guess I was confused, because I don't know why she sent those ones.



Figure 28: Youth placed stickers on top of an image they took of other people in the session for fun before the session started.

Another place where the communication was unclear was at the start of the session when the families were encouraged to play with stickers informally before we started. The conversation started with a photo of some of the participants taken by Kalani. Naomi then added stickers showing expressions both on top of a head and on the floor. She also placed a pizza sticker (since they were eating pizza). Kalani added a microbe sticker making a face. Naomi used the stickers to comment on the photo her mother took.

However, when asked afterwards, Kalani didn't explain in detail why she added the microbe sticker. Kalani did speculate as to the reasons behind Naomi's stickers, though. For instance, she speculated that Naomi used a smiling poop sticker to cover a face in order to hide the face.

Interview 3:

144: Kalani Okay. That one, probably they're hungry with the pizza.

145: Daniel The pizza. So, you think they're hungry?

146: Kalani Yeah, hungry or they like the pizza. They're eating.

147: Daniel Anything else you think about this one?

148: Kalani This one? They don't like their face to be seen with that, so they cover it.

149: Daniel Yeah. What do you think this one meant, this face?

150: Kalani That face is quiet.

151: Daniel Is quiet.

152: Kalani Yeah. Leave me alone, something like that.

Kalani's deciphering or interpretation of the message wasn't entirely correct in this instance. Rather than trying to hide a face, Naomi was more using the sticker in playful jest. Overall, Naomi was more asking why her mom took and posted the photo rather than asking her mom to leave her alone. These two messages aren't necessarily incompatible, but it is interesting to see how there is some difference in interpreting the overall message.

Interview 3:

148: Naomi Yeah. The marshmallow because of the face, like why'd you do that.
And the poop, I don't know. I just ...

149: Daniel So, you were wondering why your mom put that monster and pizza on
there?

150: Naomi No, why she took the picture.

This shows the two could communicate with stickers while not focused on the kitchen chemistry task but that they likely need time to understand how each other used stickers. However, there seems to be a fair amount of context involved in their relationship that could impact interpretation and result in miscommunications with the current usage of stickers.

Playful Co-Learning. The second family group that I am using as an example focused on a different requirement. This requirement I am calling playful co-learning. While not diametrically opposed to the clear visual communication requirement, there are some important differences. The playful co-learning was more focused on exploration of stickers.

This playful learning started before the family began the task of picking the ingredients. The playful usage of stickers included a variety of examples. The participants described the goal of the usage as having “fun”. That is not to say that the stickers were unclear or not visually communicating like the previous family example. Rather the focus was on having fun first, communicating an idea second. I will go into examples of this sticker usage.

The first example happens at the very start of the session. The start of the session is a social period while eating pizza. They were given and introduced to the iPads with stickers during this social time to give them an opportunity to familiarize themselves with the technology

outside of the Kitchen Chemistry task. This was the first (and not the last) example of the usage of stickers being not only for fun but to convey that they were having fun.

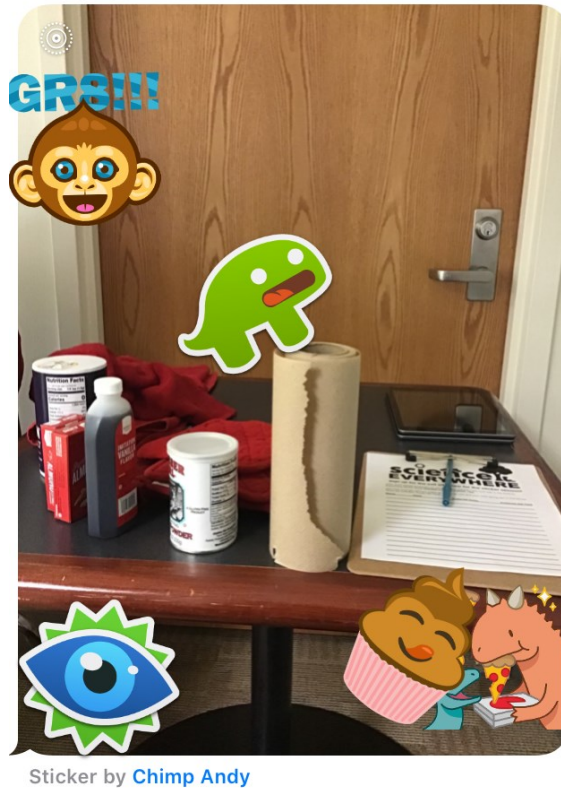


Figure 29: Youth playfully placed sticker on an image they took of the ingredient table.

Interview 3:

- 91: Jasmine Oh yeah, then I sent that to like, show everything we were doing. Then those were like the cupcake one and the eating the pizza one was because we had pizza and cupcakes for baking. Then an eye one to observe everything that's occurring in the photo since there were the iPads and the ingredients. Then like, great, just to say this is fun.

The playful behavior not only existed during the early parts of the session but was seen throughout. One example of playful sticker usage was also described as a filling time while

waiting for their mom to post images related to the Kitchen Chemistry task of “buying” ingredients. In other words, the two sisters playfully used stickers while waiting to use stickers to respond to their mother.

Interview 3:

93: Jasmine Yeah, we were waiting for her to send photos, but she didn't.

94: Daniel Yeah, I remember there was like a problem with the camera usage or something going on. She finally sent it, an image.

95: Jasmine We said, yes, like that's what we want. I don't remember sending that. I don't know. I don't think I sent that. I don't know. I don't really know what this is. I think we were just exploring.

When the time came to use the stickers to communicate with their mother, their meaning was still understood. The sticker usage by the two sisters took the form of what was essentially a query asking for more photos of ingredients from her. Sierra correctly interpreted her daughters' usage of stickers and the meme gif was accurate. Overall, Sierra understood the core concepts of what her daughters were communicating with the stickers.

Interview 3:

102: Sierra Okay. You know, in the summer I was just asking, you know, how did they like those. So, if it was like a big no-no, then you know, they would put a face or something.

103: Daniel Let's see.

104: Sierra Yeah, this one, it was here. Yeah. That's it. Yeah.

105: Daniel What do you think this one meant? It wasn't a sticker, but why do you think they sent this image?

106: Sierra It was not by accident? Oh, they didn't understand what it is I'm supposed to be sending.

107: Daniel Like waiting?

108: Sierra Yeah, waiting. Yeah.

Overall, it was understood by the sisters that the playful usage of stickers was a way to learn how to use them. Play was a way to learn how to use stickers by exploration.

Interview 3:

105: Jasmine I didn't really know about stickers before we started, because I didn't really update my phone. I don't know why. So, afterwards I decided to update it. So, then I got the sticker update. That's when I started exploring all the stickers and stuff.

106: Daniel Okay, so partially, I prompted you to learn about stickers then?

107: Jasmine Yeah.

Swapping over to the mother's point of view, she also described how play helped her and her daughters to use stickers. In particular, Sierra described a key part of this play. Sierra picked a single sticker pack that depicted various different flowers because she liked to use flowers. This explains why the flower stickers were used by her when communicating with her daughters. It was her connecting something of interest to her with the activity at hand while exploring stickers.

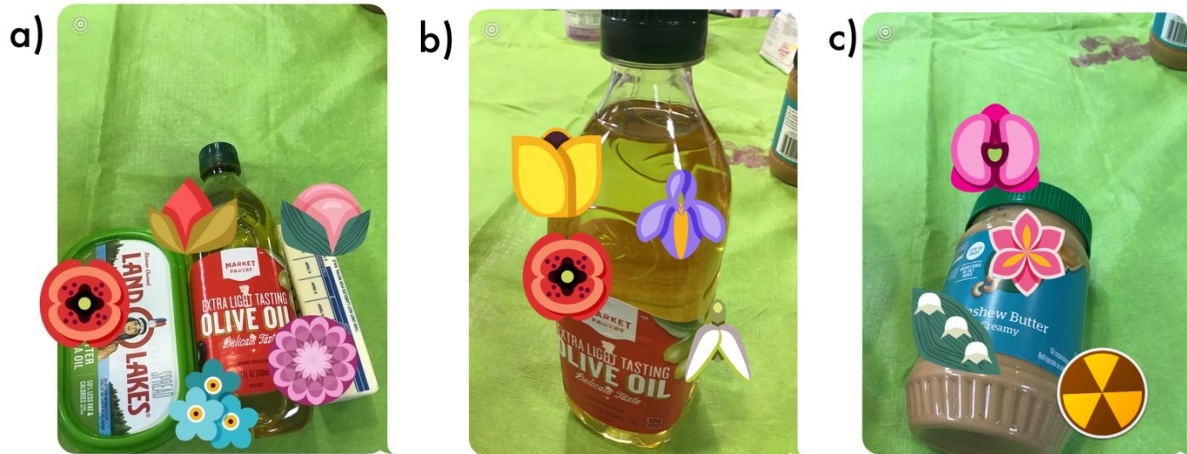


Figure 30: The mother of the youth later placed flower stickers on the photos of ingredients she took earlier because she liked the flower sticker pack.

Interview 3:

85: Daniel So, that's when you sent all of these in a row. I noticed that you were putting some stickers on these ones.

86: Sierra Yeah.

87: Daniel So, what were you doing there?

88: Sierra How good I liked those.

89: Daniel So, you liked the flower stickers?

90: Sierra Oh yeah, I loved the flower stickers.

There were other examples of families using playful exploration to learn how to use stickers. Overall, they had some similarities where either family members or friends would use stickers in a way that focuses on having fun. The behavior was primarily seen with the younger participants, but it was also seen from the parents as well.

Discussion

In this chapter I focused on understanding how the real-world interaction dynamics between youth and their parents would impact the ways they understand and use digital stickers. It is important to understand how youth and parents integrate stickers into their everyday interactions. This understanding connects back to the overall question of how we can better support youth communicating their ideas with those who can help their learning. It is important to understand how stickers can be used as a way to encourage communicating ideas that may be difficult for youth to articulate for a variety of reasons.

The goal of the sticker-based communication is to encourage youth to feel comfortable beginning to approach discussing their interest or an aspect of the interest. One way to do this is to have some flexibility of meaning that would be negotiated by those communicating with stickers. Stickers, as explained by both youth and parents, have a flexibility of meaning. It is important to understand where that flexibility might be useful to help communicate ideas, particularly from youth. This combination of flexible or ambiguous meaning of stickers during everyday communication helps to create opportunity for communication of interests between youth and their parents.

To understand this flexibility of stickers in this discussion I will look at how the youth and parents explained their interaction dynamics. I will explain insights into how stickers can (1) impact parental learning roles, (2) utilize interest-driven spaces such as affinity spaces, and (3) how interaction norms and new interests combine in informal learning places such as Science Everywhere when using digital stickers. In the first section I will look at how parental roles frame interaction dynamics between parent and child and how stickers might fit with those roles.

In the second section I will explain how youth see their digital spaces, where stickers might fit in when they're communicating and what ideas stickers might help to communicate. In the final section I will go into a bit of detail about how stickers can be scaffolded in events with youth and parents to encourage usage.

Parental Roles. In this section I will discuss the roles parents took on to help support their children's learning. Parental roles have been well described by previous literature (Barron, Martin, Takeuchi, & Fithian, 2009). These roles are both from the parents and their children's point of view. It is important to understand not only how the parents see themselves but also how the children see their parents to understand the kinds of communication that youth initiate (or avoid initiating) with respect to learning interests.

As described by the parents in the interviews, they often described themselves as a type of learning broker. They provide access to learning opportunities and support their children. This also includes the role of being a resource provider. The parent as resource provider was a common theme when discussing how the youth saw their parents. Finally, the last role of the parents was as a learner. The parents often framed their learning as being them learning about their children. While this could include simple understanding of what their child is learning in a general sense, the parents often expressed that they wanted to be more a part of their child's learning and learn beside them. With the three predominant parental roles expressed by these youth and parents being Learning Broker, Resource Provider, and Learner it is important to understand how digital stickers fit in with these roles.

Parents as Learning Brokers is where the parents seek out information and facilitate the child being a part of groups. The primary way this happened in this instance was where the

parent signed up the child to be a part of Science Everywhere, but they also described a few other instances of facilitating their child joining groups related to their learning interests. The importance of Science Everywhere in these groups is why a Science Everywhere session was chosen as the setting for having a scaffolded introduction to how to use stickers. The parents were already familiar with the setting and engaging their child with it so there was already a connection.

This parents' role and the importance of the Science Everywhere setting leads into the next role. The child seeing the parent as a Resource Provider is an interesting wrinkle. The children seeing their parents as only resource providers, especially in the instance of the Juliet, could be seen as a source of conflict or as a barrier. The children explicitly stating they limited communication to parents to text message and specifically text only could be seen as problematic to the introduction of any other media to the interaction dynamics. In contexts like this, stickers having potentially ambiguous or flexible meaning could be a boon to help the child feel more comfortable with communicating ideas. This need to minimize the risk associated with communicating was seen in several different ways when children talked about their interaction dynamics with their parents.

It is also important to understand the focus of both youth and parent on the role of Resource Provider as a limitation. Rather than being a limitation to broader communication the role can instead be a valuable starting point for integrating stickers to assist communicating ideas. Instead of merely seeing children initiating conversation with their parent for the acquisition of resources as a limitation, scaffolding the usage of stickers was a means to acquire resources. In the instance of the Science Everywhere session, the stickers were used by the

children to tell the parents what items they needed to complete the brownies they were baking. The youth were able to use these stickers to acquire the items and largely the parents were able to understand what their children were communicating with them.

Finally, with the role of Parents as Learners it is important to understand how the parents framed stickers from this event. Parents that were part of Science Everywhere valued learning alongside their children. They even took lessons and methods home and adopted the learning with their children as part of their everyday lives, such as bringing home Kitchen Chemistry concepts like precisely measuring ingredients while making cupcakes. In a community like Science Everywhere, this means the parents could potentially bring the scaffolded sticker activities home and start using stickers that they saw being used during the session.

Further study is required to determine if digital sticker scaffolding would have longer-term impact on the interaction dynamics between youth and parents. But the comments from all participants was promising regarding how they saw stickers fitting into the parental roles and being able to understand the meaning being conveyed by the stickers.

Stickers and Interest Spaces. In this section I will look at how stickers can fit in with youths' already existing digital landscape. It is important to understand how youth already have set spaces and ways in those spaces to communicate digitally. The participants in the study generally kept their interaction with their parents to text messaging only. That isn't to say the youth were not on other platforms but rather that their interaction with their parents were kept to text platforms such as SMS Messaging or iMessage.

The youth did use other platforms. They talked about how they shared images and details about things they liked or interested them. As previously detailed, how youth use and navigate

online spaces to communicate their interests is described by Affinity Spaces. These communications were with their peer friend groups, though. When asked about if their parents were included in their activities on other social media platforms such as Instagram or Snapchat, almost all youth said they did not communicate with their parents at all on those platforms.

This digital platform landscape paints a picture of youths effectively siloing off the spaces where they feel comfortable sharing information about their interests from their parents. Obviously, this is to be expected as indicated by previous studies on youth social media landscape (boyd, 2007; Lewis, Pea, & Rosen, 2010). But it does leave the problem of how to facilitate youth communicating their interests. If they do not want to or do not feel comfortable with communicating these interests with their parents using already available social media platforms the question becomes what space would be useful.

Building off of text messaging and finding ways to enrich the experience is one approach. Youth already discussed how they value text messaging their parents. As stated in the previous section, youth used text messaging as part of their parent's providing resources for their learning activities. Including stickers in those text messages has some potentially underestimated effects. While the ultimate intent of including stickers with text messages is to help youth communicate details of their interests, the details need not necessarily be contained in the stickers themselves.

In other words, the stickers do not need to be about the interest. In fact, one learner stating that stickers increased interest level just by using them in a conversation points to an interesting possibility. This also aligns with how Naomi and Kalani used stickers to largely communicate simple yes and no responses rather than using stickers with more complex meanings. These yes and no answers progressed to include more personality over time, from a

simple yes and no binary selection of ingredients to the more animated “EVERYTHING” response later while using the stickers. Stickers can start as purely being a way to try to direct or increase interest in a conversation. This could potentially go both ways with parents adopting sticker usage to increase interest in communicating about a certain subject too – similar to how the youth described getting used to their parents starting to use emoji.

By scaffolding sticker usage experiences to have the baseline of just using stickers as a way to indicate simple interest in general lowers the bar when it comes to understanding stickers. One of the understandable critiques of stickers is that they can be very complicated, where the meaning of stickers can be opaque and many different stickers could mean the same idea that is being communicated. By helping people to use stickers to just express a single concept without worrying about the specific details initially lowers the need for having to have a large *sticker vocabulary*, in a sense. Youth and parents could then potentially build up more detailed meanings for stickers over time as they use stickers with each other. Again, this is similar to how emoji have taken on extra meanings beyond the simple illustration of the object as people began to use them more (Alshenqeeti, 2016). With stickers having the extra affordance of being able to be placed on top of images or text it has the potential to be more interactive than emoji which are limited to inline text. Further research should look into the evolution of sticker meaning as groups of people such as youth and their parents negotiate meaning of specific stickers over longer periods of time.

Structuring Sharing with Whimsy. Finally, in this section I will look at the goals and affordances stickers provide in light of the Roles of the Parents and the Interest Spaces of the youth. The primary affordance that stickers provide to assist with communicating interests is

what I refer to as Whimsy. Whimsy is a playful quality that serves to help communicate potentially passing interests. This idea is about low stakes expressions of interest. Youth made it clear that they take ideas such as appropriateness and privacy into account when they communicate. They pick the method and frequency of communicating based on what is essentially a risk assessment. They also discussed how stickers have a more open interpretation of meaning. Digital stickers could potentially help youth to communicate ideas that they may not be certain about because of their more whimsical quality.

Exploration using whimsical stickers may at first look like essentially play. Using playful interactions as a way to explore has been described with multiple contexts including different technology and spaces (Andrée & Lager-Nyqvist, 2013; Barab, Gresalfi, & Ingram Goble, 2010; Barron, Martin, Takeuchi, & Fithian, 2009; Hamilton et al., 2014). A playful approach was seen during the Kitchen Chemistry session not only from youth but also from their parents. There were examples of youth and parents adding stickers to pictures of each other to have fun between structured parts of the Kitchen Chemistry session. Giving the playful moments and allowing for more unstructured communication while scaffolding sticker usage allowed for this more whimsical communication between youth and parents. Having opportunities for spontaneous play has also been described as a way to encourage social engagement around learning (Andrée & Lager-Nyqvist, 2013).

An important consideration when designing or structuring events that implement stickers is to account for a combination of both serious and playful use. The more whimsical usage can be used to demonstrate how to use stickers during relatively common interaction dynamics. In other words, allow for youth and parents to use stickers in personally meaningful ways. This

includes things like using stickers they like but may not be immediately relevant to the activity at hand. It also means allowing behavior like covering each other stickers and understanding the dynamic that exists when people use stickers to cover things. In the future it will be important to better understand the dynamic of using stickers to modify someone else or the sticker as this free form editing of other people that could also potentially be seen as violating community norms.

Overall, it will be important to understand how playful interaction with stickers develops over time and how that impacts the interaction dynamics between youth and parents in the long-term. Structuring stickers to allow for playful and whimsical moments that can help to increase communication will require understanding the norms of the communities and space the youth and parents are a part of. This understanding of the context can be built up over time by understanding the important parental roles that stickers can integrate with while also understanding how and when youth feel more comfortable communicating digitally. Building up the structure and scaffolding of stickers would need to be flexible where it initially starts as communicating relatively basic ideas such as general interests or things like yes and no responses. Such usage though can quickly become more complex, even in a single session, to include more aspects of personality and whimsy.

Summary

Stickers appear to be potentially valuable for encouraging youth and their parents learning moments where interests and ideas can be explored through playful interaction. More work is needed to understand when more ambiguous stickers might be more useful for communicating as well as how this would look outside of informal learning contexts. One specific example that could be important to expand upon is how to scaffold learning to use

stickers in an immediate family group context such as at home rather than a multi-family session of Science Everywhere. Are there patterns for how stickers are used flexibly and are these patterns different between families? Never-the-less, in this initial exploration, stickers do seem to be a valuable tool to help youth communicate their interests, not only with their peers but with their parents as well.

Chapter 8: Conclusion

In the previous chapters, I have detailed how youth discussed their interests and how those interests could be illustrated by specific design features of stickers (e.g., color choice) in Chapter 5: RQ1. In Chapter 6: RQ2, I detailed the diverse ways that youth use stickers and how these uses can be described in terms of vocabulary (i.e., the meaning behind a sticker being similar to a word or string of words) and grammar (i.e., how stickers are used together or with other images or text to compose meaning). And finally, in Chapter 7: RQ3, I went over a real-world scenario with youth and their parents and how such interactions can be scaffolded to integrate stickers into already existing interaction dynamics.

Together these findings reveal a picture where stickers can support playful interactions with youth (and potentially their parents) and their interests. Such interactions can potentially facilitate rich communication about their interests that youth may not be able to accomplish with only verbal or written communication. Stickers have this ability because they are a way to create symbolic metaphors. Before I talk about how stickers are used to communicate ideas as symbols, it is important to understand what stickers are (and are not). Stickers are (1) objects that usually are an image but can also include text or purely be text, that (2) have the ability to be placed or “stuck” on top of another object – including other sticker and (3) often (but not always) come in packs grouped in themes or common artistic styles. Stickers use these properties to then communicate ideas symbolically. While a sticker is usually an image, the idea being communicated is not necessarily limited to that image. How stickers are used impacts the meaning the sticker(s) represent(s), as discussed in more detail in Chapter 6: RQ2 when

providing examples of how stickers were used in storytelling. In essence, stickers communicate ideas symbolically using a combination of the sticker's image with the ability to "stick" the sticker on another object. This "sticking" ability is what separates stickers from similar symbolic ways of communicating like emojis – emojis are limited to in-line text characters and do not have the free form ability to be "stuck" anywhere. Stickers allow for more complex compositions based on sticking images anywhere.

The previous comparison touches on an interesting aspect of stickers: stickers can be either physical or digital. Stickers originated in the physical medium, indeed predating the concept of digital stickers. The existence of both physical and digital stickers and the three features of stickers I described above are important. While physical and digital stickers are not completely interchangeable – there is no easy way to use a digital sticker in a physical medium or *vice versa*. Still, the fact that physical and digital stickers share these important affordances allowed me to explore important aspects of how stickers might be used by youth to communicate ideas. While the future directions of my study are focused more on digital stickers, it was necessary to use physical stickers in studying the first two research questions when studying the basics of how youth think about using stickers to communicate interests and then how they use stickers to communicate their ideas. The goal of my research was to better understand how youth would approach using stickers in everyday life contexts. Due to a combination of the limited existing research on stickers as well as how digital stickers are still relatively new, I needed to consider how to study stickers without being limited by the current limitations and constraints of digital sticker interfaces. To address these limitations, I started with cooperative inquiry techniques which leverage physical prototyping to help youth conceptualize future technologies

and their uses without the youth having to confront the current limitations of digital sticker technology.

Specifically, I explored these concepts using physical stickers with cooperative inquiry between youth and adults during the co-design sessions that made extensive use of physical artifacts (Druin, 1999). Exploring stickers using cooperative inquiry allowed my later analysis to focus on how the act of “sticking” stickers might allow youth the freedom to direct how they communicate with each other and adults. Once I completed a preliminary analysis of these design sessions I could then progress from using physical stickers to using digital stickers. The co-design sessions with physical stickers pointed out potential ways that digital stickers integrate into already existing interaction dynamics between youth and other people in their communities. This information was important during the creation of the later sessions that looked at youth-parent interaction dynamics more specifically. In this conclusion chapter, I will look at how my dissertation study developed over time as my understanding of how stickers could be used evolved during the data-collection sessions. I will then explain of how my findings create a picture of how stickers can be used. Finally, I will go over some potential future directions for research into using stickers as symbolic metaphors to communicate.

It's Been a Long Road...

My dissertation studies were part of the larger Science Everywhere program. I chose to have my study as part of the Science Everywhere program because it provided access to an everyday learning ecology. While “learning ecologies“ is somewhat of a broad term, it often refers to community models that combine elements of both formal and informal learning (Sangrá et al., 2019). Science Everywhere was focused on how technology can help youth to

communicate their learning in both informal and formal learning environments. This necessitated Science Everywhere having several different levels of community involvement, social supports, and social interactions. For example, Science Everywhere included a community leader who referred to himself as a “Communitizer” who brought local children and adult community members together from across neighborhoods. Science Everywhere also included previously existing informal support networks between parents and families (Clegg et al., 2023). This amalgamation of networks was a rich environment in which to understand how stickers could be used, not just in a lab setting, but potentially across many different types of community and informal settings.

It was important to me that I was able to look at how stickers could communicate youth interests as part of a larger learning ecology. While my study did not measure learning, I felt it was useful to study the design and usage of stickers as a part of this larger learning ecology. The Science Everywhere sessions involved a rich community that was invested in both everyday learning and in helping to create new programs and technology to support their learning. Importantly, having the sticker sessions as part of this community allowed me to have a previously existing context that helped me to investigate how stickers were used by youth in community settings relevant to their learning and interests. For instance, the real-world community life exploration (i.e., the Kitchen Chemistry session) was a core part of investigating the interaction dynamics between youth and their parents seen in the RQ3 chapter.

As my dissertation study progressed, I found that each design session raised new questions about ways to better integrate stickers into the informal learning environment in the Riverdale Park area in Maryland. Rather than proceeding with my originally planned comparison

of different place-based learning environments I decided that it would be more fruitful to focus on the Maryland-based Science Everywhere environment and have a more in-depth look at how stickers could be used effectively in this rich community. This resulted in me deciding not to focus my study across sites. The second site at the University of Washington, due to a variety of factors, did not interact with their participants for as long as the University of Maryland site. The Maryland site had partnerships with community organizations and relationships with youth and their parents for years. The amount of contextual data available there allowed me to more closely tailor the sticker sessions to align with community needs based on previously collected data and thus allowed me to gain more nuanced insight that was more specific to the everyday lives of the youth and their parents.

Originally, a sticker journaling activity was meant to gain further insight from the home environment of the youths about how stickers were being used there. I set out to use participant diaries/journaling to gather data about how stickers could be used in a home setting without gathering a lot of potentially sensitive data from the youth about communications in their everyday lives (i.e., avoid having full access to their social media accounts and messaging apps). The Sticker Journaling was semi-structured with prompts to try to see how youth would use stickers based on a specific goal. Unfortunately, this was not well-aligned with how Science Everywhere fit in the overall community ecology. Due to the place of Science Everywhere as an informal science learning event, it was challenging to structure the journaling in a way to encourage participation with the journaling consistently outside of the main Science Everywhere sessions. The journal prompts I used asked youth to engage in activities with their parents and to write about and reflect upon them. However, this would not have been feasible in Science

Everywhere sessions because parents were not present in most sessions. To address this difficulty, I chose to expand upon the framework of the Science Everywhere design session that the youth and their parents were already familiar with (i.e., iMessaging). The aim of this focus was to gain more data from Science Everywhere sessions that were already part of the informal learning context.

Data was gathered at participant's homes using the Science Everywhere app. Unfortunately, the Science Everywhere app did not have sticker functionality. Additionally, building stickers into the app and only studying stickers there would have lost the advantage gained from using a platform such as iMessage that was already used by youth and parents. iMessage is one of the primary communication mediums where parents and youth discuss – and even negotiate – everyday life and events. Using iMessage effectively increased the ecological validity of my study because (1) youth and parents were already reporting using iMessage as a platform for day-to-day conversations – including conversations and negotiations about learning – and (2) the iMessage platform exists beyond the Science Everywhere community. That is iMessage is not limited to a specific subset of people in a community like a university-developed tool. Essentially, iMessage usage was a more general-purpose tool already used in their everyday lives while the Science Everywhere app usage ended up more focused on just the immediate Science Everywhere sessions. I used iMessage stickers rather than making an entirely new platform because youth and parents described how important iMessage was in their everyday interactions. I wanted to embed in this already existing ecosystem to see how stickers could practically work, rather than limiting my observations to set locations.

To compensate for the loss of these more place focused data sets I facilitated a session focused on fully integrating stickers into the Science Everywhere ecology in a way that felt natural (i.e., during the Kitchen Chemistry session). Rather than trying to scaffold stickers into their everyday lives before understanding how youth and parents would prefer to use them, this session allowed me to scaffold sticker usage in the iMessage platform that youth and their parents were already comfortable using. The stickers were less likely to feel intrusive upon already existing interaction dynamics. Instead, I could examine how stickers could be integrated into the Science Everywhere slice of the larger community ecology – specifically by using a Science Everywhere kitchen chemistry session. Parents and youth talked about how they took lessons from Kitchen Chemistry sessions in the past and integrated them in their home environment. This indicates how important and potentially impactful such sessions were to the families and how they engaged with not only science but with each other. The goal was to understand how digital stickers could be integrated into such a session and to understand the potential for stickers to be similarly adopted the youths and their parents’ everyday lives.

While I did not have the opportunity or time to continue a longer-term study after the Kitchen Chemistry Session, the initial feedback from the parents was promising. In the post interviews, the parents discussed how they could now see the potential value of using stickers to communicate. The parents talked about how the structure of the session helped them to see potential ways for stickers to be useful, not only from the interactions with their own children, but by looking at how the other families used stickers as well. The parents overall expressed some interest in using stickers more in the future.

While my dissertation overall shifted away from trying to understand how stickers could be more generalizable between different places by comparing stickers in more places, it provides a stronger example of potential ways to tie stickers more deeply to contexts. Importantly, it shows that there is a link between communication/social, storytelling, and play. The youth frequently engaged in playful storytelling in the design sessions. This including the more overt examples of integrating a videogame like CoD to more subtle expression such as creating essentially poetry with stickers to express their ideas artistically. This kind of play and storytelling was also seen during the kitchen chemistry session with adults where youth and parents would use stickers to modify each other. These examples show the potential value of stickers to communicate potential learning interests between youth and their parents. This is an important finding that aligns with previous literature about the importance of play and storytelling to encourage youth to identify with learning dispositions Barab et al., 2010; Andrée and Lager-Nyqvist, 2013; Brom et al., 2016). Indeed, supporting play is even one of the parental roles that, while not explored in my study, points to the importance of supporting these playful interactions (Barron et al., 2009). Future work could look more closely at how stickers, storytelling, and play could be integrated to assist communicating a wider variety of interests for not only youth but parents as well. The results from my dissertation do provide a rough roadmap for key parts to focus on when looking at how to integrate stickers into interaction dynamics to help youth better communicate their ideas using symbolic metaphors.

Stickers, Science Everywhere, and Communication

In the three Findings chapters I focused on defining and exploring my three research questions. These research questions examined how stickers can connect to the interest of youths

(RQ1), how stickers are used and organized to communicate interests with other people (RQ2), and how stickers can contribute to interaction dynamics between youths and their parents (RQ3). These chapters provided a picture of how stickers could potentially be used by youths to illustrate their interests and communicate those interests in a way that could help uncover or connect to everyday learning opportunities, as well as to increase engagement with learning. In this concluding chapter I will summarize how stickers can support interest-based and place-based learning as a way for youth to communicate using symbols. I will detail some takeaways from this research, including some logical next steps for research and potential implementation of digital stickers to help youth communicate their interests.

Playful Interactions with Stickers. Throughout this dissertation, I have made the argument that stickers can serve as a symbolic language to illustrate interests. One way that stickers can be used to communicate is in playful interactions. Playful interactions were especially evident in the Sticker Pack Design Session from RQ1 where youth would communicate not only their interests but also related events (i.e., engage in gossip). Specifically, in RQ1 the youth participants talked about how they would use stickers to illustrate interests, such as using stickers to create scenarios or stories similar to those they saw when they were playing video games. This social story telling was also present with the Expressions group where they would discuss their interests while making stickers as part of their larger social context (e.g., gossip from school or social media). Storytelling while using and designing stickers was essentially a form of playful interaction. The importance of storytelling is why RQ2 was adjusted to focus on better understanding how stickers could be used as part of telling a story (i.e., how the meanings of stickers are created and interpreted while telling stories).

The focus on better understanding both the meaning of the stickers and the meaning of how they were used was because the wider conversations around stickers – especially with the CoD group – required some background knowledge of the meaning associated with the stickers. In the instance of the CoD group, it helped when both communicating parties had some familiarity with the content, for example understanding how players can change the color of their guns to reflect their self. Not sufficiently understanding an interest space is, of course, a common occurrence. It isn't possible to be able to be an active member of every interest space. It is likely unrealistic to expect a parent to understand the symbols and jargon being used by their child for every unique interest their child has (e.g., it is unrealistic for the parents to know the difference between every entry in the CoD series like the youth did).

Thankfully, as seen in the Kitchen Chemistry Session in RQ3, a combination of structured usage with opportunities for playful exploration of stickers provided both the youth and their parents with the required scaffolding. Stickers as a playful element can help a youth and parents to communicate an idea without having the level of mastery of content knowledge around that concept that they might otherwise need to be able to communicate the concept verbally. Essentially, the youth may feel more comfortable communicating with stickers in a way that may feel more informal or playful than if they needed to use words that they may feel they lack sufficient mastery of. The Kitchen Chemistry session had examples of parents using stickers with their children and being able to describe what the youth were doing and expressed a desire to use them more to help better understand the desires of their children. Additional ways outside

of community events could also be structured (e.g., similar to the example of sticky-notes on a fridge communicating messages as described by one participant family).

This playful communication I observed between youths and with adult mentors, teachers, and parents (e.g., the “poopy face” sticker used by a youth communicating confusion to their parent) has implications for parental learning roles and games for learning. While stickers are often thought of as being rewards for mastery, like badges, they could serve other purposes outside the immediate scope of a game. My work suggests that stickers can help a child to introduce a concept or idea, and continued use of stickers could help reinforce exploration as the child gains mastery through learning opportunities (i.e., more traditional formal/informal learning). For instance, a sticker associated with a videogame such as CoD could be used outside the context of that game. In the specific example from my data, the act of shooting zombies with guns was turned into a way to express how they want to remove garbage from a watershed to make it cleaner and healthier. This playful usage of stickers to combine these ideas while engaging in conversation about their shared interest in the game was facilitated by the ability of stickers to combine these two different ideas together symbolically. Stickers could potentially be useful for assisting future face-to-face interactions by helping youth to illustrate new ideas beyond the scope of a game or informal learning setting. For instance, while this specific playful interaction happened in an informal learning environment, my findings suggest how play was used in other everyday contexts. There were other examples from interviews illustrating playful usage outside of Science Everywhere such as using stickers that replicated the look of iMessage text bubbles to “edit” the text someone else sent as a form of a prank. While I do not have direct data from that event due to the specific instance happening outside of a data collection session,

youth being able to recall playful usage of stickers and provide examples seems to indicate the importance of play.

Youth may leverage meanings they associate with stickers from a game to communicate similar meanings outside the context of the game. For example, as described above the CoD group mixed the concept of shooting zombies (bad things) with removing trash (a bad thing) from a watershed cleanup site. Mixing concepts like this could help the youth express ideas quickly in a way that would be open to further exploration through face-to-face communication. Does the youth think a particular river or body of water needs to be cleaned up and would they like to get involved? This is a relatively simple example, but more complex communication of interest could be possible as the youth and those they are talking to develop a more robust and nuanced understanding of specific stickers over time. In this way, stickers can be a way for youth to extend playful exploration from a game to their real life, everyday experiences. Stickers as a playful way to illustrate a desire or interest can be a useful framework for youth to integrate their interests into the everyday learning environment. For instance, the expressions group used stickers to illustrate details about their interests by adding stickers on top of them. Stickers can be used to highlight important aspects of an interest or to add more detail, such as how a youth put a frowning face next to a computer playing Minecraft to indicate the servers were down.

The results from these sessions show that the playful storytelling while designing and using stickers often included elements from affinity spaces. This includes examples such as how information from CoD communities influenced the design of the CoD stickers or how playful gossip about popular culture was important for the Expressions group when designing their stickers. However, this connection between playful stickers and affinity spaces was focused on

the connection at an individual level. Future design and usage of stickers likely needs to more fully explore how stickers are selected from affinity spaces. In idle conversation and interviews from the youth and parents from Science Everywhere, discovery of stickers seems more passive or often coincidental rather than through actively seeking new stickers.

This is not surprising as stickers are likely not required as part of an interest's affinity spaces. Discussion within and between affinity spaces is often framed as being written or verbal discussions (Gee, 2015). Understanding how not only the individual youths and parents make the connection between interest and sticker but how an affinity space's community does as well could be a valuable way to connect stickers to interest. It will likely be important to better understand how youth and parents choose digital stickers, including how they obtain them. Such a study would likely include moments that allow for reflection or explanation of how the stickers were selected and then analysis to understand how to help youth and parents add to their vocabulary of stickers. One way to integrate this into future sessions would be to ensure face-to-face moments such as those the *physical* sticker design session offered to better learn about why children selected and used specific stickers. A more guided process might help youth and parents to consciously build up a repertoire of stickers during play that can then be used in other situations to illustrate a point or interest. This structure was already seen as being successful with assisting the parents to understand and use stickers with their children in the kitchen chemistry session. In these instances, play provided both a useful time to learn the range of meanings of stickers and also encourages their usage in an environment where a more structured formal language (e.g., scientific language) may be perceived as too rigid. When a youth needs to express

interests from more informal spaces (i.e., affinity spaces) they may not know how to communicate using formal language.

The Simplicity and Complexity of Stickers. Understanding how languages or things that can be roughly described as similar to language develop in a learning ecology can be difficult. This is not a simple or ordered process (Lemke, 2002). The goal of my dissertation study was to understand how youth and parents learn to use stickers while avoiding literacy pitfalls where youth can be left out and not have their needs considered. This is why I focused on understanding the ways youth used stickers to communicate. Regarding the patterns of how youth make meaning when using stickers, my findings suggest that there are two main things that stickers afford youth when communicating. The first key affordance of a sticker is that it is easy to understand how to use stickers. Users can take a sticker and adhere it to an object, such as a piece of paper, a bench, or other physical object for traditional stickers. Youth in interviews often described either the act of sticking a sticker or an event where they would use stickers, such as using a scrapbook. For digital stickers, the youth had largely similar descriptions – even saying the same as physical stickers but digital.

Of course, digital stickers have slightly different affordances where they are usually placed on images or text in a digital platform such as a text messaging app. But stickers in other apps (e.g., Kidpix) were also referenced by youth. Indeed, Kidpix is an interesting example that has been historically used to help youth with literacy in more formal learning environments (Eisenwine and Hunt, 2000; Golden and Erb, 2001; Figg and Jamani, 2011). This simple affordance of being able to easily edit a composition – specifically with "sticking" in my study – was well understood by youth and their parents throughout the studies. The Kitchen

Chemistry session and the interviews with youth and the parents illustrated how both youth and parents easily picked up on how to use stickers to communicate, both in structured and unstructured parts of the session. There was generally no need to explain how to use a sticker – digital or otherwise.

However, my findings suggest that in this relatively simple interaction, it can sometimes be difficult to decode what the stickers mean specifically. Youths and parents described the problem of filtering the important information. For instance, as described in interviews with youth and parents, if you use a sticker of a cat holding a basketball it could mean the game of basketball the sport, playing basketball, a cat, interacting with a cat, or literally a cat playing basketball. The potential range of meaning when using stickers then becomes compounded when using multiple stickers together to create a compound meaning.

This range of potential meaning caused some skepticism from some parents when they were asked about how to understand stickers without any scaffolding. As previously discussed in the RQ2 and RQ3 chapters, it can sometimes be difficult for a parent or youth to understand the meaning behind a sticker by itself. In RQ3, during the part where they could only communicate with images and stickers, the youth would sometimes use stickers that literally had the word as part of the sticker to help convey the important detail of yes or no when choosing an ingredient. This usage example suggests designs should encourage stickers to be used as part of a larger discourse rather than to outright replace other kinds of communications. With stickers being used in the longer-term between participants, users could also start to develop their own jargon in smaller groups – such as an immediate family. I observed participants start this process during

my studies, such as youths and parents favoring a small selection of stickers while they built up their vocabulary.

Understanding the meaning of stickers is then further complicated when you factor in how stickers are used by “sticking” them on objects. For instance, in RQ2 how the stickers were organized was important when the youth were illustrating key components of their story. While you can use stickers by simply placing them on or near something you can also have more complex usage behaviors like placing stickers on top of each other repeatedly as a technique for editing a message. When scaffolded to account for this range of usage, this forms a nice usability curve – initially easy to pick up with more advanced forms of usage developing through exploration.

The flexibility of stickers is also a potential advantage, though, since it allows stickers to be used in potentially new ways to communicate new ideas. Stickers can have meanings ranging from a relatively simple one-to-one word replacement to more complex compositions that can encompass a range of subjects and actions. The sticker can even have both types of meaning at the same time. This range of meaning can be an advantage when it comes to stickers being flexible for youth to be able to illustrate something they wish to talk about – especially as part of a dynamic interaction such as face to face conversations. Further work is needed to understand how best to take advantage of this flexibility of stickers.

The main goal of my research was to understand how stickers can be used by youth to illustrate and communicate interests. Affinity spaces are a valuable place where youth explore their interests (Gee, 2005). It is important to understand how to connect to these spaces using not only text but also imagery and symbols (Davies, 2006). Stickers is one such image-based way of

communication that has only begun to be researched. As I've shown in my dissertation, stickers have valuable affordances that other image-based technologies do not have. Overall, stickers represent an easy to pick up but hard to master way to illustrate ideas that can be positioned as a way to encourage playful exploration over time between youths and parents. As seen in RQ3, stickers work effectively when used with faded scaffolds in the short-term (McNeill, Lizotte, Krajcik, & Marx, 2006). Including stickers as one part of a larger discourse could encourage communicating new ideas rather than the primary focus being how to communicate ideas as a whole. Essentially, *stickers should not be thought of as solely a technological solution*. Using the concepts of sticker vocabulary and sticker grammar from RQ2 would likely also assist when ideating the design of such systems to better understand how stickers might be scaffolded as part of a larger discourse in a community.

Limitations of Stickers. Difficulties and Opportunities. Digital stickers, as currently implemented in mobile technology, are effectively siloed to individual platforms. While physical stickers also have constraints in their usage (such as the ability to use physical stickers being constrained by needing to buy packs of a finite number of stickers), digital stickers also have a potentially significant limitation when it comes to sharing. Digital stickers usually cannot be shared between different social media or social messaging platforms. For instance, you cannot use stickers in Apple's iMessage and then expect to use the same stickers in another app such as Discord. I discuss how this limitation impacts the potential usage of digital stickers in research from an HCI perspective. But I also detail some potential opportunities to help mitigate this limitation when it comes to the design of the technology overall. There are ways to account for

this limitation to still provide a meaningful way for youth to use digital stickers to communicate and express their interests.

The portability of stickers as symbols used in a platform is not a problem unique to stickers. For instance, “custom” emoji, symbols that behave as and are used similarly to the standard emoji, are also often similarly siloed within platforms. For example, custom emoji are a frequent and important feature in online spaces such as Twitch Chat (Barbieri, Espinosa-Anke, Ballesteros, & Saggion, 2017; Heikkinen, 2021) and Discord (Schirra, Holmes, & Rhee, 2018). These spaces use custom emoji, not just the standard emoji defined by the standards body. These custom emoji are defined by the owners of the channel in the case of Twitch and by the owners of the server in the case of Discord. These custom emoji are usually illustrating memes specific to the channel or server. Essentially, they reference shared events or the memory of the community. While the custom emoji are defined by these channels and servers, they’re also often able to be used in other channels and servers. For instance, someone could use an emoji from a discord server that discusses a specific video game in a discord server that discusses another interest, such as new community servers for organizations such as a school. This usage of the emoji would be a way for someone to show or highlight their interest outside the original space.

Digital stickers could potentially be used in a very similar way across communities. However, where stickers would be different is how they could be placed in more unique ways. Rather than being constrained, such as how text chat constrains emoji usage to in-line with words, digital stickers could be used with text or images in new ways to allow more creativity. There is similar usage of stickers in online spaces, such as general-purpose messaging services like Snap Chat and iMessage. For instance, in iMessage stickers can be used on any part of the

timeline's text or images, even overlapping previous stickers. Effectively, stickers provide a way to edit messages. One participant even described such a scenario of using stickers to edit a message to humorous effect. However, stickers are also increasingly used in video-game spaces such as Overwatch that encourage gamers to identify with the characters (Ruotsalainen, 2022). However, these spaces do not have as natural of a cross interest usage of stickers compared with how Twitch and Discord do with emoji. There is currently no way to take a Snapchat sticker and use it in iMessage or to take an Overwatch sticker and use it in another game such as Apex Legends. More work would likely need to be done to allow for more cross usage of stickers between spaces rather than limiting them to a space. This would facilitate using stickers to communicate an interest outside the original interest-space. In other words, using digital stickers as part of a multipurpose platform, where users interact around a range of topics, would likely be an optimal usage for implementing stickers to help youth integrate their interests and everyday activities.

Future Directions

While my dissertation focused on a single population of youth and parents, I feel my research has a few natural inroads into other groups. Stickers as symbolic metaphors can potentially be used to assist with communication with a variety of needs. The population that I focused on were from a traditionally underserved community in regard to science learning. The community overall had strong supports with family and community resources to assist with youth exploring their interests as part of their everyday lives. Expanding my research to other populations would likely also require supports such as material and time from adults to assist the

youth in expressing their interests in a way that requires the adults to learn new ways of communicating.

One such population where further research into digital stickers could be valuable is that of individuals on the autism spectrum. There is a robust field of research around assisting those on the spectrum with communicating their ideas (Reichle and Brown, 1986; Cafiero, 2001). Examples of ways that individuals on the autism spectrum communicate include using things like Communication Boards. Communication Boards are specialized tools that have already been modernized to a degree with the advent of multitouch tablets such as iPads (Boyd et al., 2015).

While communicating using stickers would not be a novel way to describe communicating for this population, a deeper understanding of digital stickers could be valuable to integrate symbolic communication used by different populations in a way that could help people on the spectrum to communicate with a wider audience. Essentially, the use of digital stickers might provide a new medium for them to communicate symbolically. Further work would need to be done to understand how they could make use of stickers on digital platforms, including how to scaffold usage for communicating with already existing online communities.

Another area of future research includes looking into the concept of asynchronous communication. Better understanding how youth and parents navigate the difficulties of communicating, both asynchronously and synchronously, was an important part of what guided my dissertation ideation from before my final proposal that focused on the design and usage of stickers. My ideas were informed by the data collected during previous Science Everywhere sessions where youth and parents commented on some ways they navigated communicating in these two different ways.

While my dissertation research did touch upon asynchronous communication using stickers – both digital and physical – my research questions focused more on how stickers can be used in face-to-face interactions. For instance, the use of sticky-notes on the kitchen refrigerator facilitates communication between the parent and their children during the workday when their schedules did not align. The emphasis on face-to-face interactions was useful as it helped to identify ways to integrate stickers into already existing interaction dynamics between youth and their parents, both in-person and online. However, there is a very real utility for understanding how stickers could be used asynchronously and what the scaffolding or supports for learning and using stickers would look like in those situations.

One specific direction for the future research is to seek to better understand the role of the z-axis when using digital stickers. The z-axis refers to stickers coming out toward the user from the screen (i.e., placing stickers on top of other images, objects, or interface elements). For instance, stickers make use of the z-axis to represent time of placement – stickers “closer” to the user are more recent – compared to other text elements where the y-axis (i.e., scrolling up or down) usually indicates time. Having two different dimensions for indicating recency could create friction for communicating ideas. These concepts represent an area of ongoing improvement for digital communication in general and not just for digital stickers (see how Apple’s latest version of iOS 17 includes improvements for communication of text using replies and stickers asynchronously).

Overall, my work suggests there are several avenues to further explore the idea of digital stickers helping youth to communicate their ideas and interests with their peers and adults – and possibly even helping adults communicate their ideas as well. I discussed two ideas, that of

understanding how stickers could be used by people on the autism spectrum as well as how stickers could be used not only to help illustrate ideas in synchronous but also in asynchronous communication. But there are also exciting areas where stickers could be used in the future, such as in augmented reality, where the divide between digital and physical stickers might become blurred as technology allows for this more mixed reality.

Glossary

Affinity space: Affinity spaces are communities (frequently with a large and diverse set of participants) where people engage with what are commonly fan-based activities (e.g., Star Wars, World of Warcraft, and Pokemon). These communities come together around a common theme to interact and work together in activities related to a theme related to the common interest (e.g., writing fiction or using math to argue a feature of a game).

Audience: The audience is the person or people who the person using the technology is communicating with either in reality or merely who they expected/intended to communicate with in the conversation (i.e., the person may not know who is in their audience all the time).

Call of Duty: Abbreviated as CoD². A popular first-person shooter videogame youth often referenced in their discussion and design of stickers.

Design affordances: An affordance is an element of a design that helps the person using the technology to do something. For instance, stickers using generic images is an affordance to help someone communicate an idea visually to another person.

Design constraints: A constraint is a limitation of the design of a technology that impacts the potential usage. Constraints, while inherently limiting, can also help focus usage of a design towards a specific area based on the design affordances.

Place-based learning: Place-based learning looks at the learning happening associated with a physical place, such as a classroom, park, museum, or home. Place-based learning focuses on the

² Call of Duty and all other trademarks (i.e., Apex Legends, Bitmoji, Discord, Flickr, Instagram, iMessage, KidPix, Overwatch, Pokémon, SnapChat, YouTube etc...) are registered trademarks of their respective owners.

contextual information relevant to a place, such as the history of fishing and the impact of water pollution on a local river.

Participatory design: Participatory design involves participants as participants in the design process to contribute ideas and give feedback. In my study, I will be focusing on a participatory design methodology called cooperative inquiry that involves participants in early ideation of the technology as well as providing feedback for improvements on completed design products created by researchers.

Parent: The parents in this study are the adult care takers of the youth participants in this study.

Science Everywhere: Science Everywhere is an informal science learning program that seeks to help people see science in their everyday lives and then explore that science. As part of this process, participants also help design technology that helps them compose and share this science with other members of their community.

Semiotics: The study of signs or symbols and the sense or meaning making of those symbols by individuals and groups.

Sticker: A sticker is an image that can be applied over the top of another image, text, or 2D surface. Stickers, while traditionally physical, can be abstracted into digital objects that retain the general affordances and constraints while being used in social media networks.

Sticker Grammar: A pattern of usage of stickers in conjunction with other objects such as text, images, or other stickers.

Sticker Vocabulary: The meanings an individual assigns to their sticker repertoire.

Youth: A youth in this study is a participant who is a member of a learning community Science Everywhere. These youth are aged approximately 7-17 years old in the design session and skew older for focal youth.

Appendices

Appendix A: Sample Protocols

Recruitment Message

Hi ____ This is Daniel from Science Everywhere. We have asked ____ to take part in a new science everywhere activity involving digital stickers on iMessage. Would you have time for a brief phone call to explain the study and what it involves?

Place Observation Pre-Interview

Preamble

- Thank you for agreeing and taking the time to do an interview with us. There are no right or wrong answers to any of our questions, we just want to hear your thoughts and opinions. You may also end the interview at any time.

Start the interview with questions about the display and their perceptions about it.

- What do you know about the large display for Science Everywhere? If they haven't seen it, walk them to it and show it to them. At least point at it.
- What do you think the display could be used for?

Programs in the Community

We'd like to know more about the programs in the community and your level of involvement, if any.

- What programs can you recall the church / school offers for children in the community?
- Do you or your family participate in any of these programs? If so, which ones?
- Are there other community programs you would like to know more information about? If so, which ones?

- Interest-based learning
- If you could share one interest on the large community display what would it be?

Scientizing

- What is science to you?
- Is there any way you work with children in the community to help them think like scientists? If they just say “yes,” ask them to elaborate and give examples.
- Do you see your child or children in the community doing science in their everyday life? Tell us about it - can you share some examples? The interviewee may have answered this in the previous question. If he/she did, move on to demographics.

Demographics

As a reminder, all of these answers are confidential, and you can skip any question you do not wish to answer.

- What is your age?
- Gender
- Position within the church/community, if any
- Any other comments you would like to make about your relationship with the community or community programs?

Place Observation Post-Interview

Preamble

- Thank you for agreeing and taking the time to do an interview with us. There are no right or wrong answers to any of our questions, we just want to hear your thoughts and opinions. You may also end the interview at any time.

Start the interview with questions about the display and their perceptions about it.

- What do you think about the large display for Science Everywhere?
- Have you interacted with the display? If so, in what way?

Programs in the Community

We'd like to know more about the programs in the community and your level of involvement, if any.

- What did you see in the display that was related to programs in the community?
- If they haven't used the display, skip this question.

Interest-based learning

- If you could share one interest on the large community display what would it be?

Scientizing

- Have you seen any science around the community and the display?
- Has the display provided you any new opportunities to work or do science with children?
- Do you see your child or children in the community doing science in their everyday life? Tell us about it - can you share some examples? The interviewee may have answered this in the previous question. If he/she did, move on.

Display Interaction Activity

- Now we'd like to show you an example and learn more about what you think of the posts in the display. Let's look over some of the posts. Pick one that you find interesting, and let's talk about it.

Before having the participant pick a post, take them to the "Most recent" list and allow them to scroll and pick one from that list.

Have the interviewee pick a post, take a note and picture of the selected post, and then ask the following questions about it:

- Explain what you think was going on when this post was made.
- What do you think the child who made this post is learning or sharing with this post?
- What do you think you could do to help or engage this child further?
- Would you like to give this post a badge?
- What do you think would be a good example post for each of the badges? Post can be a real one or something they come up with
- What would we like to know about events here?
- What else do you think the display could be used for?

Parent Focus Group

- Generally, what we want to know:
 - How did they [parents] use it?
 - What posts stood out the most/do you remember?
 - Have you seen any other adults use the display?
 - Did you see any posts with badges?
 - Do you remember what the badges are? Can you give us an example of what post would give each badge to?

- What stood up about those posts or the badges themselves?
- How did they see children use the display?
 - Do you remember any posts from your child?
- What would they like to see in the display?
- What could they use it for?
 - What do you think we could use the “Events” for?
- Any concerns about the display?

Sample Sticker Journal Entry Prompts

- How did you use a sticker?
- Draw or describe when you used the sticker.
- What happened after you used the sticker?
- Did you feel like a scientist, investigator, designer, or engineer?
- Chose an idiom. [example of idiom provided to define the word] Replace one word with a sticker in the idiom and share it with your parents.

Child Sticker Pre-Interview

- Describe how you would use a sticker.
- Would you use a digital sticker, such as in a social media app in the same way as a sticker you put on paper?
- How have you used stickers before?
- Has anyone ever given you a sticker?

- Why do you think they gave you that sticker?
- For this section, we'll go over some of the stickers made during the summer jam. We want to talk about how you could use these stickers on these photos of Solid Rock/other science places.

Child Sticker Post-Interview

- How would you describe the Science Everywhere stickers?
- Did you use the Science Everywhere stickers the same way you use a paper sticker?
- What was a cool time when you used a Science Everywhere sticker when talking to someone online?
- Did someone use a sticker on something you posted?
- Why do you think they used the sticker?
- For this section, we'll go over some of the stickers made during the summer jam. We want to talk about how you could use these stickers on these photos of Solid Rock/other science places.

Parent Sticker Interview

- What were some of your child's interests in science, engineering, or math?
- Where do they go to learn more?
- When did your child use the Science Everywhere stickers?
- What kind of post did they make?
- Did your child ever share a sticker with you?
- Did they share someone sending them a sticker with you?

- How would you use stickers in those situations?

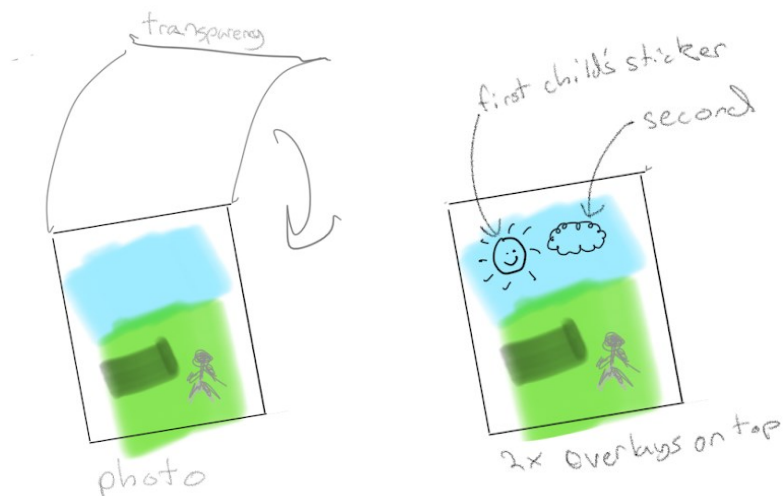
Sticker Design Session Protocol

Introduction (30 min)

- Go over the nature and Minecraft activities from last week
- Show photos from those activities and ask what they were doing (need a clarity filter or something on top)
- Introduction about stickers
- Ask about if and how they have used stickers and digital stickers
- Explain that we want them to design their own new digital sticker pack that we will put on a social media network

Initial Layering (~45 min)

- Have each group decide on a theme for a sticker pack (e.g., cats, a cartoon or other tv show, etc) (maybe show an example, theo's pin helped)
- Introduce the photo they will be drawing on
- Ask the group to share what they remember or think was going on
- Give each child a photo with transparency on top and pens
- They are tasked with drawing a sticker from the pack on the photo (just one, try to limit drawing over the entire thing)
- Rotate the photos within the same group and have a new child draw on top of a new transparency to add another sticker
- Do this one more time (get alcohol swabs for erasing)
- Share back in the group to have the kids talk about the stickers they made and why they used them

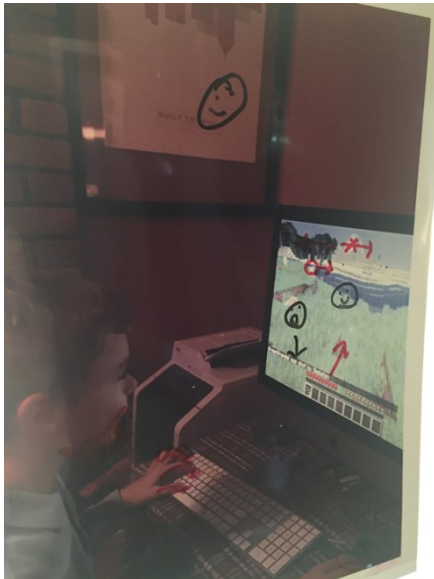


Remix and Share Back (~45 min, break between for lunch/social)

- Have each group pick a sticker pack sales-person
- This child will go to another group and “sell” the sticker pack to the by describing it and showing their example
- The group will then have the children of the group draw a sticker from that pack on a new transparency with at least one of the sticker created (can remove layer if too busy)
- The group then shares back what they did and he sales-person takes the designs back to the original group and shares them
- Ask children which social networks they would use these stickers on and when/who they would use them with
- We then have a whole group share back where the sales-person describes the sticker pack and how it was used by their group and the other group



Pilot Example



Girl in black, Boy's smiley face in red, mom's arrows in red

Story Design Session Protocol

This session has the children combining stickers from two different packs/themes (e.g., shoes and cats). They combine the stickers on a piece of paper that has a thought bubble drawn on it (along with name, age, and a question about what app they prefer, could change/add/remove). They can create any story or connection they want, it does not need to be

related to what they did this summer (see examples below). They will then share back with a few people around them (small group). After that they will exchange one sheet of stickers to gain a new sheet. They will then repeat by adding to the piece of paper they already used with the new stickers. Then share back.

Essentially, this is to help me develop the journaling/share back protocol for when they use stickers in their informal everyday learning.

- Materials: stickers, paper/worksheet, scissors, tape, pencils/crayons/markers
- **~25 min:** welcome back
 - pizza, social
- **~15 min (can make shorter as needed):** opening
 - Opener question: briefly share something cool you did this summer
 - Transition question: have facilitators talk about what they enjoyed about the summer jam session
 - I'll detail an example of one of the stickers designed (and Beth said she will do this too)
 - Essentially, talk about the sticker design session and what was produced
 - [**Make up the groups** - can do this as the kids are eating, since groups will be dependent upon who's there]
- **~15 min:** round one
 - Open with piece of paper is them composing a story or idea to post to their social media app where they are going to use stickers
 - Prompt: *"Think about a chat session that you had with a friend... like a discord session about minecraft or an imessage about a trip. It can be from the summer or just recently, like when school started. We're going add stickers to these*

conversations. Think about how you would use stickers in a conversation like it ...”

- have kids work individually on following steps
- one worksheet, 2 different sheets of stickers, pencil/crayon/marker
- have them combine the stickers from the two sheets and create a story or explain a connection, etc... they add/illustrate using the writing implement
- **~10 min:** share
 - have them share what they did with another around them
 - they then exchange one sticker sheet (so they have one sheet from before and another sheet someone else had)
 - Before moving on have them briefly explain/write what they shared on the piece of paper
 - Make sure facilitators ask/write down (kids can too) **what sheets they started with (and why if possible) and why they picked the new sheet**
- **~10 min:** round two
 - add to their previous combination of stickers with the new sheet of stickers
- **~10 min:** share
 - share back with group
 - also work in questions regarding what app (social or otherwise) they could do what they did today
 - Have them write the connection down
- **~5 min:** end with explanation/teaser for filtration content (transition for next session)

End product example (from pilot)



Kitchen Chemistry Session Protocol

Purpose

The purpose of this session is to have richer usage data for stickers in a place-based learning scenario. During mid-point interviews it was uncovered that parents still largely were learning their child's interests from traditional roles such as providing materials and not as much through everyday conversation (let alone with stickers). By replicating a known place-based learning scenario of kitchen chemistry that integrates these roles (e.g., providing materials) I am trying to essentially recreate moments where their children could communicate more but don't. By requiring both children and parents to use stickers at certain friction points I am attempting to see how children might convey information to their parents and how parents can interpret and then convey their thoughts back while using stickers since that is unknown.

Plan

- Mixing location: Patuxent YX Lab (plus tables)
- Store location: first floor conference room

- Cooking location: second floor kitchen
- 10 min: Icebreaker and introduction
 - Explain that they will be doing a kitchen chemistry question where they will investigate different types of fats and how they are used in cooking
 - As will be using stickers, as part of the activity they will have iPads preloaded with stickers and already active iMessage apps used to communicate between the different iPads
 - Quick demonstration of how can use stickers
 - Question: each iPad has a picture posted in a chat use stickers to modify the image with no text, try to guess who you're chatting with
 - I'll be answering any questions you have about stickers
- 5 min: debrief from the icebreaker and what they thought while using the stickers
- 10 min: Brownie Planning
 - Give brownie recipe with slots for different types of fat
 - Ask what kinds of fats they can remember being available to buy at the store
 - Have them decide two different kinds of brownies they'd like to make such as fudge-like
 - Child text your mystery buddy in another group what you plan to do using text and stickers
- 10 min: Shopping trip
 - Parents go on a shopping trip to another room taking their iPads but not the recipe
 - Parents must "buy" ingredients they think are needed for the different recipes
 - Communicate back what doing with the children by using photos of the ingredients and stickers to communicate ideas

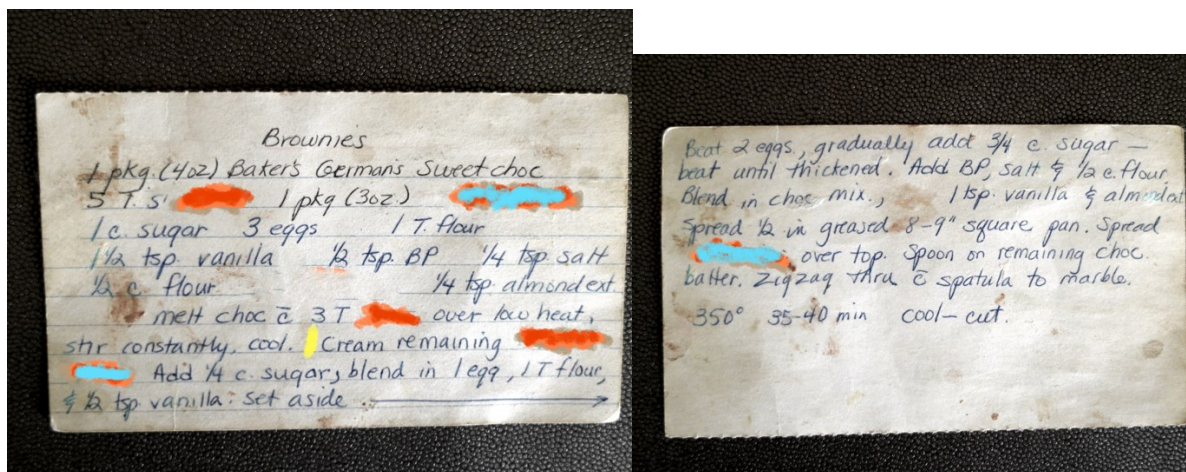
- Children communicate back with stickers only to express what they think would help them get the type of brownies they decided upon earlier (e.g., fudge-like)
- Parents negotiate back using stickers
- I will be with the adults to help with tech
- 10 min: Mix ingredients
 - Make the different brownies
 - Child will text mystery buddy again with updates
- 40 min: Bake
 - Parents will leave again with iPads to bake
 - Communicate back updates on the brownie with images and stickers
 - Try to communicate predictions of how turning out
 - Children communicate back their thoughts (can use text and stickers)
 - Come back and try out brownies
- 15 min: Debrief (during bake... do this with adults and children mixed or not?)
 - Ask questions about thoughts for every step of the night
 - What did they observe about fats while mixing?
 - Any surprises when making the brownies? When using stickers?
 - One time stickers worked really well?
 - Any part of everyday life that is close to what did tonight?
- Total time: ~1 hour 30 min

Materials

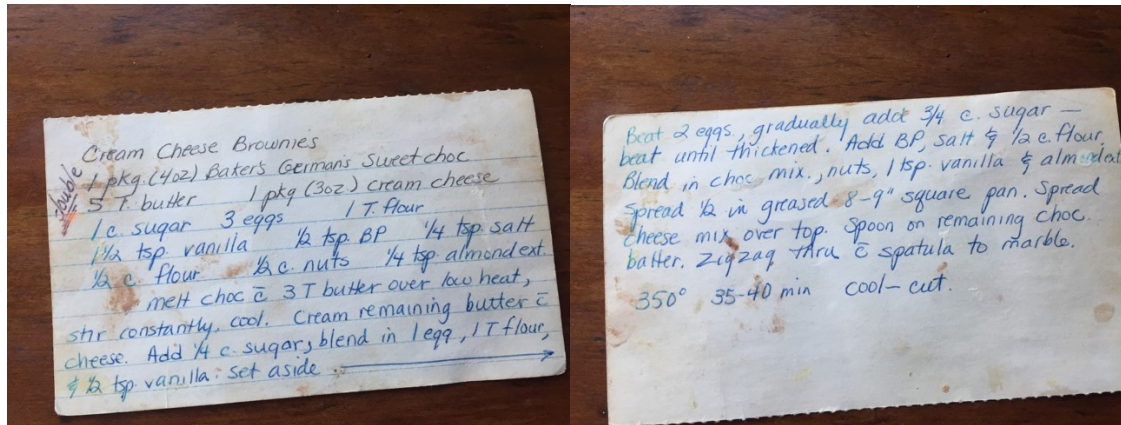
Will have 4 families so need ingredients for probably about 6 batches to account for changes and goofs.

- at least 2 Science Everywhere facilitators (including me)
- 10 iPads preloaded with stickers and set up for iMessage communication between each other
- 2 rooms and access to an oven
- brownie supplies (in progress)
- selection of fats (e.g., butter, cream cheese)
- pans
- bowls
- mixing equipment
- measuring equipment
- pizza

Obscured Recipes (sources of fat removed) note: c with line over means with, BP = baking powder



Non-Modified Recipe (will obscure the fat source, can remove nuts too)



General Organization

- Optimal headcount: 3 parents, 4 children (main sticker participants who did at least 4 journals, I believe)
- In other words, 3 family groups
- Activity is kitchen chemistry, question is if it should be new concepts or same concepts but presented in a different way
- If same concepts will have to find way for the participants to take the science reasoning further than they have in the past
- Regarding sticker usage, main point is to get data about parental usage and understanding since journals had minimal information (children were not providing many details nor really followed up in questions)
- Will need to have parents and children separate and then come back together at least once during activity so they can communicate using iMessage on iPads in a more realistic scenario
- Have parent or child go on “shopping trip” to another room and require communication using images and stickers
- Can have another part where maybe parent leaves to do something else near end so children then have to relay results and parents ask questions using stickers

Rough Plan

- Free play chat with stickers and iMessage between parent and children
- A question of the day intro
- Possible explorations: unsaturated vs polysaturated fats and miscibility (cream cheese, lard, oil, etc), what part of the egg helps with miscibility and egg replaces (repeat), salt and other flavor enhancers (MSG)
 - Want simple so focus is more on sticker usage and less on understanding the activity
 - Still have room for people to scientize and act on questions, though
- Second variable time could be when parents go off to bake and children explain outcome they prefer and parents decide time variable (since can't really do temperature)
 - More heavy on interpretation and two way communication, potentially
- Looking at different fats (first option) is probably the best and works with brownies/cookies that are easy to complete in a short period of time
- 1) children convey choice of fats during shopping trip
 - Parents take photos of items and children sticker to represent
 - Not only different kinds of fats present in "store" but other options like different sugars and flours
- 2) children convey what outcome they want and parents interp
 - Parents then convey choice and outcome back
 - Parents can make changes but have to try to interpret child wants
- Close with survey
- Have video in rooms or just audio? (or both)

Post Kitchen Chemistry Interview

Child

Interest Learning (usually about 5 min)

1. For this study I'll be looking at things that you're interested in learning about. Can be at home, here, school, anywhere else. What is something that is interesting that you learned this last week?
2. What is something interesting to you that your parents may not think involves learning?
3. Do you know anyone else or a group who shares this interest?
4. How do you communicate with that group that shares your interest (or is interested in things that you're interested in, too)?

Place-based Learning (about 10 min)

1. Think about Science Everywhere, what were the different things you remember learning at Science Everywhere.
2. Who did you talk to about Science Everywhere (both during sessions and after)?
3. Who did you share cool things you learned at Science Everywhere with? What about things that you didn't think were so cool?

Social Media (about 5 min)

1. Now I'll ask you a few questions about social media. What is the social media app you use the most when communicating with people?
2. How do you share with people on social media currently?
3. What topics do you and your parents talk about on social media? Has there been any changes?

Stickers (about 20 min)

1. More specifically about stickers... Describe a sticker for me. What about a digital sticker?

2. Let's look through the journal entries so far. Find the time you used stickers that was the most fun. Why was it fun?
3. How about the coolest usage of stickers by someone you were talking to?
4. Did you use stickers on your own last fall or during the break?
5. Looking at your usage of stickers from the Kitchen Chemistry activity, walk me through your usage.
6. What would it look like if your parents were using stickers all the time when talking with you.
7. Would you like your parents to use stickers when talking with you?
8. Any other thoughts or questions for me?

Parent

Interest Learning (10 min)

1. This study looks at interest and learning. While this is mostly about your child's interests and learning I will be ask you about your own interests and learning too. To start off what are your interests?
2. Do you share any of these interests with your child?
3. What do you think your child is mostly interested in? Why do you think that?
4. How do they engage with this interest during school? During winter break?
5. What do you think they are learning from that interest?

Place-based Learning (15 min)

1. The next part is looking at how place impacts their interests and learning. What do you think your children learned at Science Everywhere?
2. Any specific things you remember your children learning from Science Everywhere?

3. Did your child share what they learned from Science Everywhere with you? Anyone else?
4. How do they communicate what they learned with you?
5. Where do you learn? (Can be Science Everywhere or somewhere else)
6. How do you share what you've learned?

Social Media (10 min)

1. Now I'll ask you a few questions about social media. What is the social media app you use the most when you communicate with people?
2. How do you share with people?
3. Is there anything you'd like to share that you can't share as easily?
4. How did you use social media with your child during the winter break?
5. Would you like to use social media with your child more, less, or is it about right?
6. What is one thing you learned from your child via social media?
7. What time did your child share something that surprised you. Was there a misunderstanding or was it something implied by you or your child?

Stickers (20 min)

1. Finally, I am going to ask you some questions about the sticker journals your child has been doing. Describe stickers for me. Digital stickers?
2. Do you use digital stickers?
3. Does your child use stickers when talking to you?
4. Did your child ever try to teach you how to use stickers?

5. Looking at your usage of stickers from the Kitchen Chemistry activity, walk me through your usage.
6. Do you have any thoughts or opinions how you might use stickers more to communicate with your child?
7. Do you have any questions for me?

Appendix B: Code Books

Interview Code Book

The first round of coding was based upon the initial research questions and the initial conception of what the dissertation contributes (from the proposal). Initially research question 1 was exploring how interest and place driven learning interests could be discussed using stickers as a form of participatory design tool. I coded the interviews (pre, mid, and post) of the parents and children that were the focal learners for the sticker journaling activity. The interviews were where they discussed learning interests, how they engage in learning, and how they used stickers in their everyday lives as well as as part of the journaling exercises (where I gave them a task to communicate a learning interest in a specific way and directed them to use stickers as part of the task).

The coding book was based around trying to identify aspects of 1) participatory design tool usage, 2) general context information about communication, 3) places they talked about in relation to learning, and 4) everyday science learning such as interests.

The outcome of this coding identified that my contribution was actually something else. With that in mind, I created a new code book to code the data where real time sticker usage took place rather than how this code book was used to analyze how people discussed learning interests and stickers in more of a past tense.

I stress that while this code book did not do what I was originally anticipating it was useful for identifying specific interests of the focal learners as well as the importance of programs like Science Everywhere as a place where parents and children/adolescents can talk about interests. It also seemed to indicate that when talking in the past tense parents tended to focus on structured events (possibly because that is easiest to remember and connect questions to answers).

Overall, there was difficulty capturing the essence of the adolescent focal learners using stickers when asking them to report usage. This made it difficult to distinguish what was interest, what was place, and what was something else. Discussions were also not necessarily connected to stickers and sticker usage. It did identify what participants thought of stickers and potential usage scenarios but overall there was no real way to connect usage to place-based learning and interests. This influenced the development of the Science Everywhere Sticker Session where real time sticker usage data was collected and focused more on how stickers could be used in a more structured informal learning scenario with both parent and child present. That session was coded using the new code book.

Design Considerations

- Affordance : There is a discussion about a design feature that allows someone to do something (usually sharing or learning).
- False Cognitive : When affordance doesn't match e.g., handle that says push, plate that says pull (20.5, UX book). Examples of this showing up are when someone thinks an app or stickers should do something citing what they think is an affordance but it is not. It can also include misleading parts of a design.
- Constraint : Something that is narrowing in the possibilities. This can be intentional or more of a reality of the design (packages of physical stickers limits the number and types of stickers and this is carried over to digital stickers, sometimes even including limiting the number of times a sticker can be used).
- Mental Model : An explanation by the participant about how they perceive or think about a design. This can also include how they perceive someone else thinks about a design.

Design Context

- Emotion : Emotion is either explained or is used as an example for communication.

- Ecology : The ecology of the communication is detailed, such as what platform it takes place on or otherwise details about various mediums.

Communication

- Dyad : Explicit communication between 2 people.
- Solo : The person is asked about communication but then only details their own thoughts and no communication with another.
- Family : Communication or activity with family members.
- Group : Communication or activity with other people, this usually is friends but can be other groups such as coworkers.

Place

- SEPlace : Mentions activities that took place during or because of Science Everywhere at Solid Rock.
- Home : Mentions activities that explicitly happened at home.
- School/Work : Mentions activities that explicitly happened at school/work. Combining these two place types since they were often referenced similarly.
- ThirdPlace : Mentions activities that took place in a third place such as a library, barbershop, etc... also includes online communities such as gaming Discords.

Person/Context

- Interest : Person talks about their interests or interests of others. This is a frequently used code due to most of the interviews being about interests.
- Shared : The person shared something, often their interest but sometimes something else.

- Collab : The person talks about collaborations to achieve a goal or make something. This differs from sharing in that it is more than just distributing content.

- Effort : The person or a person either mentions putting in effort or someone having to expend effort or not doing something because something would be difficult/effort would be required.

- Confusion : Confusion happens either the participant or facilitator. This can also include confusion that happened elsewhere and it relayed via a story.

Session Transcript Code Book

This codebook was based on Lemke/how language is used in learning settings. While stickers cannot be analyzed in the same way as verbal or written language, understanding how stickers in context of communication is necessary to start to understand important aspects of design and usage.

I separated it into two sections: 1) aspects that define stickers and 2) aspects that define usage. I then coded transcripts of design sessions and the Science Everywhere session where stickers were used. I looked for these aspects to try to identify mental models and scenarios where stickers were used or attempted to be used. After preliminary analysis a new section of 3) communication was added with some of the emergent themes.

Coding to Define a Sticker (v1)

These codes are focused on the design or particular elements about the sticker itself. The codes look to help define how a sticker is created or defined by the child.

- Shape : Discusses the shape of the sticker or related object or the ability to create the shape. EX: “I can’t draw a circle. This is so small. Bam, an egg.” (sticker session, Expressions, line 253)

- Color : Discusses color in some way or the writing/drawing instrument (e.g., pen, pencil, etc.). EX: “I need red, red, red.” (sticker session, Expression, line 312), “Pen, pen, pen, pen.” (story session, Daniel Group, line 320)

- Generic Obj : References or describes the sticker in terms of a concrete object. Note: Does not preclude Interest Obj code. EX: “There’s a cat.” (story session, Daniel Group, line 346)

- Interest Obj : References or describes the sticker in terms of an interest they have or abstract idea. Sometimes indicated by expressions of “like” or other emotions. Note: Does not preclude Generic Obj code. EX: “Does it look curious?” (sticker session, Expression, line 321), “I would do Black Ops III.” (sticker session, CoD, line 30)

Coding to Define Usage of Sticker(s) (v1)

These codes are focused on the usage and context around that usage of the sticker. The codes look to help define context details that may be important to the sticker’s use.

- Size : References the sizes of the sticker, things near the sticker, or context of the sticker. EX: “Take the big one.” (sticker session, Beth Group, line 335)

- Orientation : References the orientation of the sticker relative to what it is placed on or in context of what the child expects. EX: “Yeah, I did it backwards, but that’s okay because it’s still adorable.” (story session, Daniel Group, line 260)

- On Obj : Describes what the sticker is placed on. Can be specific or general. EX: “But on the iPad.” (sticker session, Tacos, line 141)

- Near Obj : Describes what the sticker is near. Can be specific or general. EX: “Just add the “What are Those?” sticker. / To what? / To a person with terrible shoes.” (sticker session, Annot, lines 302-4)

- Obj Type : Describes what the sticker is on or near in more detail. May not describe the sticker at all. EX: “But on the iPad.” (sticker session, Tacos, line 141)

Communication

These stickers were somewhat inductive where I realized I needed a code for when they were telling a story in general or were having difficulty describing something.

- !Desc : Child had difficulty or resistance to describing an idea or concept. This can include stickers or something related to the design session. EX: “There you go. Are you going to explain what all this means? / No.” (story session, Tammy Group, lines 379-80)

- Story : Child is engaged in story telling either by self or with others. The story does not need to directly relate to the design they created or contributed to. Often times the code is used with many lines in sequence as part of a long story with interjections or questions mixed in. EX: “Because in III, I’m used to it, and in II I’d be trying to jump boots, and then I’d die, because I can’t jump boots.” (sticker session, CoD, line 37)

Appendix C: Sample Coding Analysis Visualization

CoD Group

Line Start	Line End	Total Lines	Gen Percent	Int Percent	Ref Percent	Details Percent	Story Percent	Major ≥10%	Minor <10%
1	70	70	20	43	0	0	1	int, obj	story
71	103	33	33	3	0	33	0	obj, details	int
104	208	105	8	0	0	7	83	story	obj, details
209	235	27	26	0	0	7	4	obj	details, story
236	426	191	15	3	14	5	13	obj, ref, story	int, details
427	467	41	0	0	0	0	0	none	none
468	507	40	5	5	0	3	58	story	obj, details, int
509	546	38	0	0	0	0	0	none	none
547	583	37	8	14	0	3	0	int	obj, details
584	675	92	0	14	4	4	3	int	details, ref, story
676	750	75	3	12	4	7	13	int, story	obj, details, ref

Expressions Group

Line Start	Line End	Total Lines	Gen Percent	Int Percent	Ref Percent	Details Percent	Story Percent	Major ≥10%	Minor <10%
1	70	70	21	34	9	9	17	Obj, Int, Story	Ref, Details
71	116	46	22	50	11	2	0	Int, obj, ref	details
117	222	106	2	2	3	0	65	Story	obj, int, ref
223	335	113	23	12	6	12	3	Gen, int, details	Ref, story
336	523	188	10	6	0	7	7	gen	Int, Details, Story
524	561	38	32	34	16	0	0	Gen, Int, ref	
562	578	17	0	6	0	0	82	Story	

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