“I have a tutorial for this”: The language of online peer support in the Scratch programming community

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ABSTRACT

Millions of kids are visiting and communicating in online sites and communities. While some concerns have been raised unsupervised and potentially harmful communication, a number of studies have identified great potential in kids’ online talk, especially when related to feedback on user-generated content. Yet little research has been done at scale to show whether or not positive communication practices are broadly engaged in or supported online. This paper focuses on the informal peer support present in the online Scratch community, a youth programming site. Drawing on a random sample of 8,000 comments from over 5,000 random participants on the Scratch website gathered from January to March 2012, our analysis focuses on the quality of comments about projects and identifies their constructive, emotional and functional foci In the discussion, we address what these findings tell us about productive participation, potential for future research, and opportunities for scaffolding broader and richer participation.

Categories and Subject Descriptors

K.3.1. [**Computer Uses in Education**] Collaborative learning.

K.3.2. [**Computer and Information Science Education**]: Computer science education.

General Terms

Human Factors.

Keywords

Computer science education, collaborative learning, social networking sites, social networking forums, do-it-yourself media.

IDC '15, June 21 - 25, 2015, Medford, MA, USA

ACM 978-1-4503-3590-4/15/06…$15.00
DOI: http://dx.doi.org/10.1145/2771839.2771863

1. INTRODUCTION

Children’s online participation is growing in numbers. Millions of kids are online in virtual worlds, playing games and socially networking [33, 31]. Many concerns have been raised not only about the quantity of time spent online but also about the quality of content and interaction with others as issues such as bullying, cheating, and racism have become prominent in popular news [26, 32, 36]. To address exposure to inappropriate content and psychologically harming activities, many sites have set up a number of protective supports ranging from chat filters to menus with preselected phrases and community policing [29]. In some instances parents even opt out of having their kids go online at all, leaving aside the positive and supportive experiences that kids can have in online communities [25]. For instance, creating and sharing media can be a key form of public and civic engagement [3] as well as a way for kids to exercise their human rights to communication and cultural production [10, 16]. Doing this in vast online interest-driven sites allows kids to develop community with others who have similar interests, give and receive feedback, take on roles of leadership, engage in meaning making, and develop new identities [19].

For these and other reasons, a small but rapidly growing number of online social networking forums (SNF), sites that support social networking within a wide range of “online social activities, practices and platforms” [21, p.3], are of particular interest. In these sites children and teens themselves become content contributors, alone or together with others, and join the larger movement of do-it-yourself (DIY) activities. Much of the current research has focused on documenting and understanding the products and processes of online participation found in these youth communities from mostly observational and ethnographic perspectives. There have also been efforts to provide support from the technical side such as providing tutorials [18] or engineering collaborative creative interventions [40]. Much less attention has been paid to the online peer support provided by youth members themselves, the informal practices already present in these communities that are indicative of participatory competencies that youth have developed on their own [22]. In particular, we lack an understanding of peer support practices at the large scale of the websites themselves. Such understanding of participatory competencies is crucial if we want to design communities, tools, or activities that can support online creative contributions among youth.

In this paper, we turn our attention to the informal peer commenting practices found in a youth online creative community. We chose to examine the language of support in the Scratch online community with more than 6.1 million registered users and more than 8.9

million uploaded projects since 2007. This SNF already contains many social features intended to support kids' programming contributions, including several types of "networking residues:" traces left on projects or profiles such as "love-its," friend requests, "favorites," comments, and even gifts that show that users have viewed and appreciated the projects [21]. To study the commenting practices of users, we drew on backend data from a random sample of over 5,000 Scratch members gathered between January–March 2012. In earlier analyses we found differences in the types of participation of Scratch members engaged in [13], as well as how their participation changed over time [12]. Moving beyond case study research, we asked at a collective level the following research questions about the emotional, constructive, and functional tenor of comments about projects in the Scratch community: To what degree do such comments display positive or negative affect? What proportions of comments are specific versus simple and generic? What role do comments actually play in the Scratch community? We analyze the role of comments in the Scratch community through the lens of computational participation [23] by focusing on the tone, specificity, and function of Scratch kids' comments on projects. In the discussion, we address what these findings tell us about how participation in online creative communities can be productive, what further research needs to be worked on, and how scaffolds and activities can be designed to engage all kids in richer forms of online participation.

2. BACKGROUND

We situate our research amidst larger discussions concerning kids online, in particular, online communities where *users* contribute to the main content [2, 21]. In such communities, often organized by community members rather than companies, members generate content and scaffold participation for each other themselves. This is particularly consequential for children and youth who historically have been more the recipients of media made for them rather than producers of media in their own right [22]. Yet increasingly websites, apps, digital games, and software programs are targeted toward children and youth to facilitate their own making and creativity [20, 37]. Prominent examples of these SNFs include sites for writing, videos, art, citizen science, and of course programming, the topic of this paper.

Several researchers have found rich peer-to-peer language and constructive practices in these sites. For instance, Magnifico [34] points to the positive role an authentic online audience with shared interests can play in youths' writing development. Similarly, Black [5] analyzed the productive ways that youth in an online fan fiction site provided constructive feedback to each other, helping them to develop as writers and critics over time. Curwood, Magnifico, and Lammers [11] concluded that popular online cultures help students attune to the established practices of the field, and can serve as a "springboard for students' ideas and interests" [p.684]. Yet while these studies have identified the potential of constructive comments and feedback amongst small groups of individuals or select niches in online social networking forums, little research has been done on a massive scale to show whether or not these practices are broadly engaged in or supported online.

While online creative media production in the form of writing stories, making art, and constructing other media is a popular activity, it is unclear to what degree supportive interactions take place in communities that focus on more technical productions, such as programming activities. Coding is most often thought of in terms of computational thinking [45] that involves programming concepts, practices, and perspectives to formulate both problems and solutions for people and machines to interpret. But it is only when learning coding increases someone's capacity to participate in today's increasingly digitalized world and its online communities that the worth of such capacity reaches its peak. For that reason, we focus on *computational participation* [23] which include computational practices and perspectives that make contributions within various social networks possible. In our study context of Scratch, the connection between the programming tool and the community allows kids to learn by building on their own knowledge, affinities, and experiences, socializing and contributing, manipulating virtual objects, and operating within an established set of values, all of which makes it an appropriate environment for studying computational participation. Thus, our research moves beyond an individualistic focus on computational thinking towards a collective perspective on computational participation by acknowledging the important roles of sharing, feedback, and audience in how kids learn to program in Scratch.

Previous Scratch research has already focused on what design features best facilitate kids' participation through creating, especially social and community features like project sharing, collaborating, and of course commenting. In our earlier research of this same random sample, we found that that nearly 45% of Scratch members posted content on the site [13]. Indeed, posting content was a baseline for all visible participation, followed by downloading and only then by commenting. In the Scratch community at least, commenting is one of the first signs of social interaction beyond the more one-sided sharing a project or downloading another's project [13]. Thus, although commenting is one of many optional activities on Scratch it provides one of the richer proofs of kids' participation.

Additional research has further found benefits from commenting in Scratch. Comments that provide feedback on projects can give purpose to Scratch programmers [6], propelling them to deeper programming and/or participation. When given constructive comments in a time-sensitive collaborative challenge, most Scratch creators responded with direct changes in their projects [14]. There is also empirical evidence that comments about projects are more linguistically sophisticated than other kinds of comments on the Scratch site [17, more on this in Section 4]. In focusing on the commenting practices on Scratch, we adhere to a theory of learning as a social characteristic of everyday social practices in which we participate (e.g., [43]). Learning to code involves not just the technicalities of programming language and common algorithms but draws on observing and taking up existing practices within programming communities [23]. In other words, learning coding not only encompasses an acquisition of technical skills, but should also be appropriated within a practicing social context to become functional [41].

To examine the language of online support, we build on a previous computational linguistic analysis of a random sample of comments [17]. We found that comments specifically concerning Scratch projects were more likely to have more sophisticated linguistic features than comments about other topics (social conversation, current events, etc.). Overall, our results suggested that youth were more thoughtful and engaged when commenting about projects, showing higher quantities of words (i.e., overall words, verbs, and modifiers), expressivity (i.e., emotiveness), diversity (i.e., word content and redundancy), specificity (i.e., spatial indicators, imagery, modifiers), and affect (i.e., affect words, pleasantness, and

activation). These findings raised further questions about how comments showed positive rather than negative emotions and what role specificity played in the comments. By investigating the functional, constructive and emotional tone of project comments on Scratch, we can develop a better understanding of how these practices fit into a broader perspective of computational participation, moving beyond writing code to discussing and critiquing it. Specifically, we pose the following three research questions: How constructive are project comments on the Scratch site? What kinds of emotional tones do comments about projects have on the Scratch site? What functions do comments about projects play on the Scratch site and how might they contribute to the development of students' computational participation?

3. METHODS

3.1. Data Context

Scratch is a programming tool and an online community launched in 2007. It provides an intuitive building-block structure to programming and has a low entry threshold for absolute beginners while simultaneously opening vast programming opportunities for more experienced programmers [39]. It also has a community with currently more than 6.1 million registered users and more than 8.9 million uploaded projects. The Scratch community is intergenerational but predominantly consists of kids between the ages of 8-16, two thirds of them boys, who all share an interest in programming and who contribute to the community by posting animations, games, stories, science simulations and interactive art that they make. What is more, considering that Scratch is an open-ended or unstructured environment, with no specific scaffolding provided [28], it is kids who also scaffold socialization and expertise development processes on Scratch (see Figure 1). All these features make Scratch a prime example of an online programming community focused on youth, a do-it-yourself (DIY) social networking forum and a media project-sharing site [21].

3.2. Data Collection

Data used in this study come from a random sample of 5,004 users out of 20,000 who logged into Scratch in January 2012[1]. Members on the Scratch site are self-reported 33% female and 67% male; this distribution was reflected in our random sample. There are two ways to leave comments in Scratch: on projects and on galleries (user-curated collections of projects). We studied only the comments left on projects. Out of this random sample of users, 18.5% (926) left comments on users' projects generating 36,802 comments out of which we randomly selected 8,000 to manually code into two primary categories: comments about projects and other comments, resulting in a 1:3 ratio [see 17]. Manual coding from an earlier analysis by Forsgren Velasquez et al. [17] generated 2,273 comments on projects, which formed the data corpus for our analyses. We describe these earlier findings further in the results section.

This data set has two primary limitations. First, comments on Scratch are limited to 500 characters. Second, the comments we are using in this study are completely decontextualized from their broader contexts, which prevents us from seeing who or what kids are replying to or what project they are about. This limitation is a consequence of the way we collected the data, which focused on following the actions of a random set of users, automatically eliminating the possibility of studying conversations between users. However, it does allow us to study broad trends of commenting, with the potential to put prior ethnographic studies of the Scratch community into a broader context.

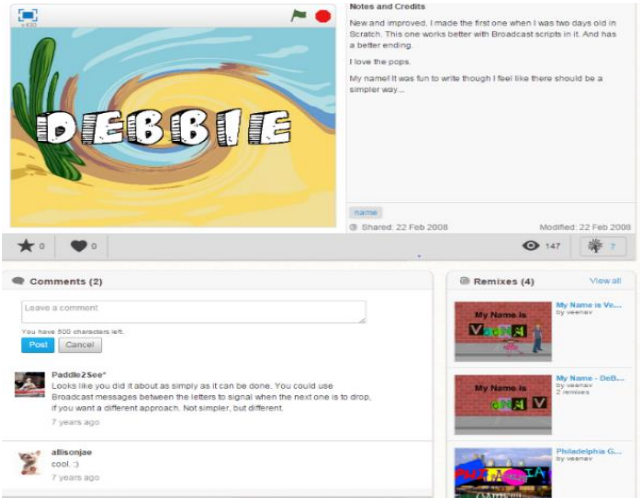

Figure 1. Scratch project with comments

3.3. Data Analysis

We conducted three separate analyses of the 2,273 comments on projects previously identified [17]. First, we made a distinction between simple and more complex, constructive comments in the data set. Second, we categorized the general emotional tone (positive, negative and neutral) of each comment in the data set. Third, we conducted a thematic, constant comparative analysis [38] of the functions project comments play in the Scratch community. For the first two analyses (simplicity/complexity and emotional tone) we used a deductive analysis approach [38], creating definitions for different categories and providing examples that illustrated those definitions (for more detail, see Tables 1 and 2 in next section). Two researchers collaborated in this process until they reached consistent agreement over the definitions. Then a single researcher coded all 2,273 comments.

To investigate simplicity/complexity we classified comments into two mutually exclusive categories: simple and specific. Simple comments are largely generic, providing little if any information about a project. These often include short phrases of gratitude or exclamatory praises (or insults) such as "Thank you! :)" or "Awesome!" A complex constructive comment had to say something specific about the project, even if it was relatively minor (e.g., "the music was nice." or "Wow! Great drawing and sounds!"). These comments often provided feedback on how a project could be improved, said what specifically was good about it, or acted as a stepping stone towards further social interaction. As it turned out, in our analysis the length of the comment was not a deciding factor in this categorization.

To investigate emotional tone we created three mutually exclusive coding categories: positive, negative, and neutral. During this analysis, it became obvious that not all comments contained

[1] When users sign up for Scratch, they are informed that research is being conducted about Scratch. Furthermore, any research published is made available to all the users on Scratch website after its publication (https://scratch.mit.edu/info/research/). The researchers of this study went through IRB approval at three universities (MIT, University of Pennsylvania, and USU). Data used for this study is public, collected with careful consideration for the anonymity of the user, and reported in an aggregate manner.

linguistic cues (e.g., excessive punctuation, emoticons, particular vocabulary) based on which we could determine their tone, which is why we added a neutral category to our analysis. Positive comments convey positive affect, such as liking, gratitude, admiration, praise, and progress, often with heavy use of punctuation (!) or emoticons (:D). Negative comments include words/phrases or imagery which convey negative attitude, or emotion, such as dislike (author or audience member), disagreement, disappointment, impoliteness (use of words such as "hate", "rude", "freak", "stinks", "weirdo", "suck", "crap" or shouting with capital letters), impatience, or lack of belief in one's own "Scratching" abilities. These might include comments such as "Total time waster!" or "too hard." Also included in this category are comments that solely point out that a project is dysfunctional/lacks expertise, or focus solely on those parts that need improvement with no simultaneous attempt to provide positive feedback or encouragement (e.g. "The barriers are a little glitchy!" or "This game is not finished ;(")." Negative comments may also include references to unethical behaviors such as cheating, copying, or failing to give credit. For instance, "no im not cheating or changing the script...i played online and i didnt cheated!!!" Finally, neutral comments give no hint of positive or negative affect, usually consisting of purely informational content including announcements, explanations, gaming tips or resource sharing. For example, "I have a tutorial for this: [link]"; "I fixed a glitch"; "I learned a trick. If you want to stay fairly straight you have to jiggle your fingers so that you go 'left right left right left right left right....' really fast!"

In the third analysis we identified the different functions users' comments on projects fulfilled. What were Scratch members trying to achieve with their comments and how was this contributing to their overall computational participation? We immersed ourselves in the data in a deliberate search of underlying patterns and themes. Using a grounded theory approach [38], we began by open coding the comments, then progressed to axial coding and relational statement formation. In all three coding phases, we engaged in constant comparison and thematic analysis amongst two researchers until consensus was reached, then one researcher coded the data in full, checking on difficult-to-categorize comments as needed, which were discussed. This process involved many thorough examinations of the data in order to organize them into related categories. The open coding phase resulted in numerous categories (n=21) all of which were defined and illustrated with an example (for more detail, see Table 3 in next section). The next step, axial coding, involved systematic collapse of related categories into a smaller number of related categories (n=6) based on similar functions they had on Scratch.

4. RESULTS

In our earlier study [17], which examined 8,000 peer comments of online Scratch project, we found that only one third of comments (2,273) were about projects while the majority of comments (5,727) were about other topics such as social conversation or current events. A further linguistic analysis revealed that comments about Scratch programming projects also exhibited statistically significant differences in 14 linguistic cues that showed not only higher quantity of overall words, verbs, and modifiers but also suggested various qualitative differences. The following sections provide an in-depth analysis of these differences, reporting first on constructive details, then on emotional tone, and finally on the functional focus in peer online comments.

4.1. Constructive Detail of Peer Project Comments

In our first analysis of the 2,273 comments on projects, we were interested in the constructive detail of project comments. Overall, more than half of the written comments about projects on Scratch were constructive: 1,315 (58%) of comments were detailed, while 958 (42%) comments (out of 2,273) were simple. Our general understanding of simple comments was that they close communication, while specific and constructive comments open new possibilities for interaction and action (see Table 1). This analysis reveals that nearly half of the comments about projects are fairly simple and generic in nature (e.g., *cool, thanks, liked it, boring, I won*), with the other half providing some detail.

Table 1. Specificity of Comments on Projects

Category	Examples
Simple	*"Cool!!!!"* *"Thanks!!!"* *"boring"* *"I won"*
Specific	"*Yea that will need to be fixed. Thanks for reporting the glitch!"* *" I have a tutorial for this: [link to tutorial]"* *"no cant be fixed sry"* *"Ok--what do I do to help you? And no I haven't downloaded it yet because I was kind of busy but now I have more time :)"* *"I don't know why but my project isn't working unless you download it. So to see it properly please download!"*

4.2. Emotional Tone of Peer Project Comments

In the second analysis of the same data set, we were interested in the emotional tone of the comments on projects. We wanted to see if comments on projects are positive or negative in tone based on the linguistic cues provided in the comment itself. The analysis revealed that only 14% (315 out of 2,273) comments were negative, while 14% (319) were neutral, with the vast majority (72%) of comments positive in their emotional tone. Overall, we judge that the tone of comments about Scratch projects is largely very positive. The findings from this qualitative analysis confirm the linguistic features of pleasantness identified in our earlier study using automated text analysis [17].

Table 2. Emotional Tone of Project Comments

Category	Examples
Positive	*"awesome :D"* *"thanks :)"* *"A new update is done :)"* *"poorly overtaken by the project released after this game is amazingly smooth addicting and entertaining. [link] And you can view the other one that has like 160 views ;D"*

Negative	*"Total time waster."* *">:O make a new character... i don't want a trollface in my series... so MAKE A NEW ONE!"* *"sorry to be fair i did help you make it"* *"Yes the idea but not actually downloading it."*
Neutral	*"I have a tutorial for this: [link to tutorial]"* *"i fixed a glitch"* *"I learned a trick. If you want to stay fairly straight you have to jiggle your fingers so that you go 'left right left right left right left right....' really fast!"* *"can i just use the card? i will give credit?!"*

4.3. Functional Focus on Peer Project Comments

Finally, for a more nuanced analysis we examined the broader range of the functional focus of project comments. We examined the relationships between different categories and crystallized them into six broader themes: motivational feedback, personalized tutoring, relationship building, agency in learning, building a following, conversational partners, and cultural competence (see Table 3). Overall, two themes dominate in terms of frequency: Motivational Feedback (58%, n=1316) and Building a Following (23%, n=521) (See Figure 2). Below we consider these two themes in particular, as well as what differentiations between simple/specific and positive/negative/neutral affect illuminate about these categories.

Motivational Feedback stood out as the largest theme of comments about projects (58%) with three main subcategories: giving encouragement (71%), posting criticism (19%), and sharing personal experiences (8%) that related directly to something in the project. The motivation theme was vastly positive, with criticism being almost the only area that showed negative affect. Half of the comments in this theme of motivational feedback were simple, and half were more specific. Encouragement accounted for most of the simple comments, consisting of short statements of praise ("*wow*," "*awesome*"), though some also included more elaborate compliments on specific positive aspects of a project ("*this video NEVER gets boring*"). Other feedback contained elements of criticism ranging from simple rare negative comments that might be perceived as demotivating feedback (e.g., "*boring*") to combinations of both positive and negative comments on the project in question ("*nice! but it only works with the flash player on turbo mode! it still worked though!*"). Many commenters also thought to motivate others by sharing personal stories of learning to program similar types of projects ("*Great project1 I like fish and have always wanted exotic ones like Discus. I have a betta and used to have two goldfish. However just yesterday one of my goldfish died of unknown reasons :(I made a fish coloring contest in case you want to enter it.*h") or giving examples of their own experiences in playing the project by listing a score or level achieved ("*88 medium. Must. Do. More.*"). It was refreshing to see that so many peer comments provided explicit encouragement. Despite appearing simple, these types of comments have been identified in fanfiction communities as not only the most inspiring for the participants, but also as those that carry the most personal and social knowledge and involve the most work within social networking [5].

The second largest theme, called *Building a Following,* includes comments aimed towards building a community of one's own followers. Subcategories of this theme included seeking support, expressing gratitude, apologies, disclaimers, announcements, or acknowledgements. These comments were overwhelmingly positive (80% with only 6% negative). By posting comments like these, members attempted to build rapport and maintain a relationship with the Scratch community. They did this by recruiting people to like or see their projects (seeking support: "*please love my game! Remix it*!"), making sure no one was offended (disclaimer: "*BTW idk how it was based on Sper_Creators Project... Oh wait... I remember... I used de music xD I'll delete this if u don't want meh using the music but it was awsome T-T*"), apologizing if someone did get offended or if there was a possibility of offense (apologies: "*sorry about the bugs I did not now how to fix them*"), expressing gratitude for resources and feedback received (gratitude: "*Thanks! it was sooooo hard*."), keeping your followers informed (announcements: "*It's reuploaded."),* or addressing the feedback they received by informing the community about their action plans for the future (acknowledgement: "*k ill make a dog one if u want*"). These comments not only testify to the awareness kids developed about the importance of the community, but point toward their intentional efforts to establish a visible presence on the Scratch site.

The remaining four themes, while less prominent in number, were interesting in their degree of specificity, suggesting that these comments may account for the richest forms of participation on the site overall. For instance, *Personalized Tutoring* (9%) included providing suggestions, sharing resources, providing gaming tips, and giving explanations. These informative comments were mostly directed to the personal growth of project authors and their followers, especially game players. Here we see evidence that the Scratch community was supportive of its members' further development and learning in a variety of different ways. Youth provided tips for the community on how to play a particular game (gaming tips: "*Use 'a' to shoot the asteroids.*"), clarifications on how certain things were done or where they could be found (explanations: "*yup its in my gallery*"), ideas on what to do or improve next (suggestions: "*Here's an idea - video games. You make a game of a video game charecter for example Mario or Link or even Kirby and Sonic!"),* and direct links to available resources that someone else created (resource sharing: "*i know u can draw da scrach meme: Bear! (go here 4 a pic of her! [link])").*

Where personalized tutoring comments provided answers and suggestions, *Agency in Learning* (5%) comments consisted largely of seeking help through questions and requests for collaboration. For instance, some youth asked other Scratchers for concrete help with Scratch (such as how to draw a particulate type of sprite), asked for explanations of a programming skill or for suggestions on where to locate a resource and even solicited collaboration on a project. These types of comments were different from *Building a*

Table 3. Functional Focus of Peer Comments about Projects

Theme	Category	Definitions	*Examples*
Motivational Feedback	Encouragement	Compliments, expressions of surprise, encouragements, and other enthusiasm	*"Awesome"*
	Criticism	Pointing out an area/project for improvement without little positive encouragement	*"Remove the music and this would be 10X better."*
	Sharing personal experience	Sharing one's own experience with the game, or sharing one's own preferences in Scratching	*"ohman I hate drawing humans c.c just draw like rats with hair they look roughly the same."*
Building a Following	Acknowledgement	Comments recognizing, appreciating, or following a commenter's suggestion	*"Thanks for letting me know! I will update the Project Notes with that shortcut."*
	Announcement	Announcing new, remixed or uploaded projects or something in preparation by providing a link	*"This is an awesome demo of my newest platformer: [link]"*
	Apology	Apology for not being able to fix the project, not being able to figure out the game, and similar	*"I'm sorry I can't make out what you're saying."*
	Disclaimer	Author disclosing awareness of poor quality, dysfunctional projects, and misunderstandings	*"i fixed it but it make the sound of the gun sound completely different (when the project is online)"*
	Expressing gratitude	Thank you notes	*"thank you! i worked hard on it!"*
	Seeking support	Asking others to visit, like it, love, remix a project, or provide feedback	*"Thanks!!! please go to my last project and see a update!!"*
Personalized Tutoring	Explanation	Explanations about the game, author, "scratching" process, where you can find something, etc.	*"and the bachground i just got off google and blurred and shrpened it.."*
	Gaming tip	Various tips on how to cheat or play the game	*"when you land on something press SPACE!!!!"*
	Resource Sharing	Announcements which share a particular, often desired, resource for scratching	*"This engine has scrolling wall jumping and is less glitchy than all my other engines: [link to engine]*
	Suggestion	Comments on how the project can be improved or what the author can do next	*"maybe you could remake one of your old poke fusions into something better"*
	Scratching tip	General tips on established Scratch practices, how things are done on the Scratch site.	*"You can download some of my games and look at the scripts."*
Agency in Learning	Seeking collaboration	Comments regarding collaborative work on a project, often in the form of a request for collaboration.	*"Puppypaws!!! The collab camp starts in Febuary! We need to remix the project!"*
	Seeking explanations	Questions seeking clarification or further information	*"is that your voice with the alphabet?"*
	Seeking help	Asking for favors, advice or resources	*"Could you draw me a dark grey tom cat waking up???*
Cultural Competence	Ethics	Pointing out ethical issues: rudeness, copyright, cheating, etc.	*"Listen up dsdude10 its a free world its not like yours works well we are inproves it"*
	Seeking permission	Asking for a permission to use or remix some aspect of a project.	*"Can I use the music?"*
Conversational Partners	Conversational replies	Replies to earlier comments that appear to be part of a bigger conversation	*"no COBRA dude -.- Don't mess up the awesome plot we already have."*
	Disagreement	Replies of disagreement with something someone said/did	*"no it isnt. connect the dots you connect dots. in this EVERY DOT CONNECTS TO EVERY DOT."*

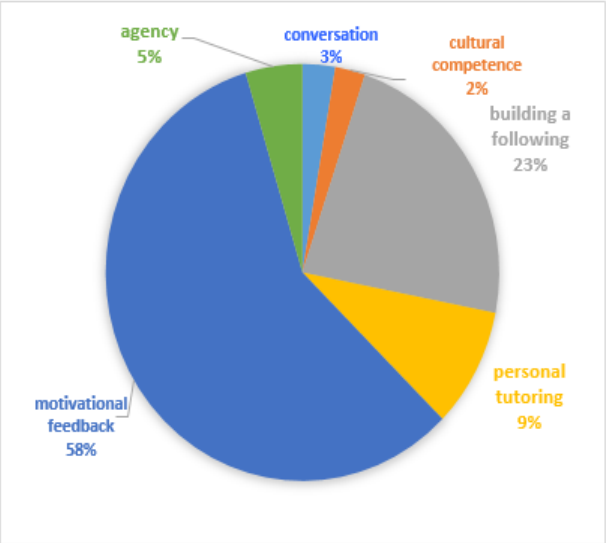

Figure 2. Proportions of themes in project comments.

Following in that they were less about recruiting attention to themselves and more about soliciting and receiving concrete help on making projects. Together these two groups of comment themes form the most constructive feedback of all the comments we studied.

One other theme, *Cultural Competence* (2%), points to the importance not just of learning to make projects but learning how to be a responsible part of the Scratch community. These comments on projects testify that in order to be part of the Scratch community, kids have to seek permission, negotiate ethics, and learn how to be Scratchers (Scratching tips). These comments embody wider, unwritten rules to Scratch community participation, rules that are reflected in the challenging conversations that Monroy Hernandez and others have noted about remixing and copying projects (e.g., [35]). Although all shared projects on the Scratch site are open-source and available to download and remix, youth were expected to respect other people's intellectual property, ask for permission, and generally respect others, which includes certain levels of politeness and respect towards other "Scratchers". Many members here also shared tips on how things are "normally" done in "Scratch."

Finally, we identified a theme that we called *Conversation Partners* (3%). These comments were very different from the rest of the comments about projects because they consisted mostly of conversational replies and disagreement. It was obvious that these comments were part of a longer on-going conversations about projects—ones to which we had no access as part of our data collection approach.

5. DISCUSSION

In this study we examined on a massive scale the trends and quality of comments about Scratch programming projects on the online Scratch site. The language of online peer support was vastly positive and encouraging in nature, and while many comments were relatively simple statements of praise or thanks, the majority of them included some level of specificity, which means that youth programmers are getting feedback on their projects. The positivity of comments is encouraging as it testifies to the Scratch community's efforts to provide a supportive and productive playground. Further, the comments revealed a functional diversity of themes, primarily relating to encouragement but also generating a following of other users, providing or soliciting personalized tutoring or advice, debating ethical standards in the community, or simply conversing about a project (for instance through collaboration). These findings suggest that the common stereotypical fear about inappropriate and harmful behaviors in massive online communities might be misplaced [44], at least where online DIY spaces such as the Scratch programming community are concerned. Though some have pointed out the negative role that discouraging comments can have on user trajectories (e.g., [7]), these may be rarer than originally thought for what concerns comments about projects on the Scratch site.

Equally interesting is the finding that developing a following is clearly a priority for many Scratchers, as it represented close to one-fourth of all comments concerning projects. The majority of these comments were simple, mostly straightforward statements of thanks or requests to "like" or view a project. These findings reveal one of significant challenges of massive online communities: the difficulty of becoming known and achieving a visible presence on the site. This is one reason why the homepage of Scratch is such a sought-after honor. Getting featured on the front page or achieving "most loved," "most viewed," "most favorited," or "most remixed" promotes visibility and almost assures that users will leave comments and interact around a project. In fact, it can be key in supporting deeper involvement in the site as it connects Scratchers to many other devoted members of the site [8]. Yet the overall positivity and simplicity of comments about projects suggest some other directions that might be of even greater interest to designers and educators: rich and deep participation in computational and constructive practices.

5.1 Commenting as Computational Participation

Situating these findings in the larger context of youth participation in online communities [21], we need to be mindful of how commenting fits into broader trends of participation on the Scratch in general. Commenters on Scratch form only 18% of users based on our research of the random sample of users participating in January 2012 [13]. Most users (55%) in our sample simply browsed the site. Of those who left traces of their involvement, creating and sharing a project formed the baseline of computational participation, followed by downloading others' projects, and only after that by commenting and other forms of social networking [12]. This means that users who did not create and share their own project were also less likely to comment or participate in any other way. Commenters are already a relatively elite group of participants on the Scratch.mit.edu site.

Of those comments about projects, close to half are "simple" in nature, not providing specific details about what is good or needs improvement on a project. From these combined findings, we judge that a majority of Scratch members do not engage in what we would label as rich forms of computational participation [23], and many of the comments themselves lack the sophistication we found so encouraging in project comments.

However, we argue that commenting is a key aspect of computational participation in the Scratch and other relevant youth production sites, holding great potential. Comments were widely

diverse in their function, suggesting rich social competence that went beyond the acquisition of coding skills. They provided encouragement about programming projects, suggestions for improvement, hints and tips about how to improve projects, and resources for becoming known in the community. Additionally, about 3% of comments reflect cultural dimensions of computational participation [23], teaching Scratch members the values and politics of the Scratch community which map clearly onto priorities for media literacy practices, especially regarding copyright and ethics (e.g., [42]). Effective computational participation requires some type of collaboration or social interactions with others such as learning to create for an audience, process feedback, or revise one's work [23]. Certain types of commenting seem to provide important ways forward in building this dimension of computational participation. Questions that remain to be answered include how to support such richer, more sophisticated commenting practices and how to facilitate these types of participation more broadly across Scratch and other DIY media creators.

5.2 Designing for Computational Participation

In shifting our discussion from an analysis-driven to a more design-oriented perspective, our findings can also provide directions on where to locate efforts to foster online peer support. To begin on the website level, our findings reveal that one key challenge that many Scratch users face is becoming part of the social community online—evident in the large amount of effort that users spent trying to generate a following or get featured on the front page. This suggests an opportunity to design ways for users to find each other beyond current means of collaborating or establishing popularity. While some Scratch users succeed in finding smaller groups for collaborative programming or role-playing (e.g., [1]), many may go unnoticed on a site where 1500 uploads and more a day have become the norm. Further, while forums can be a great place to post questions and get to engage with other active community members, they can also be a particularly intimidating area for new users to join (e.g., [8]). Young, new users may not yet have learned the necessary participatory competencies such as searching or posting tags, responding to comments, or posting on forums. While research has focused here on creating automatic personalized tutorials or other ways of learning to program (e.g. [18]), our research suggests that efforts should also be directed into developing tutorials for computational *participation* practices. Here designers should consider developing new ways to socially network that support project-based interests. As a community concerned with interaction design we can generate creative new designs for social networking that focus on promoting social collaboration around project sharing.

Other design efforts could focus on providing scaffolds to help new users develop proficiency with writing a range of comments and notes. For instance, in youth fanfiction sites, the culture of "Author's Notes" developed as a way for writers to direct the types of feedback they wanted to receive from others [4]. Many writers used Author's Notes to self-identify as novices or as English language learners, notes which were taken very seriously by different reviewers in directing the type of feedback they gave [8]. Since some youth acknowledge being intimidated about participating online, often unsure of how their Scratch projects measure up to others [27], learning to direct the type of feedback desired may be one type of scaffold that could help newbies advance in their trajectories of participation online.

Naturally, helping youth develop rich computational participation practices need not occur solely online. Special contests, challenges, or collaborations may be another opportunity to help users meet others and get feedback on their projects both locally and online [23]. Further, the design of such social events could also provide opportunities to explicitly model what constructive feedback looks like and how to leave it. We had success in one time-limited collaborative design challenge (called Collab Camp) in encouraging more participants to leave positive, constructive feedback by explicitly modeling such feedback and suggesting areas for commenting (from usability of a game to appreciations of sound effects) [40]. We also know from other research that nearly all of the users receiving constructive feedback improved their projects accordingly [14]. Local users benefited as much, or more, than active online users from this participation, learning from their peers locally and becoming more aware of the process of computing as well as its relevance to a wide audience [15]. Helping youth recognize the connection between specific, constructive conversations offline in person and productive commenting practices online in DIY sites like Scratch may be one path forward to promoting richer and broader participation in such sites.

5.3 Researching Computational Participation

Future research on this dataset or on Scratch.mit.edu in general could illuminate other aspects of computational participation. For instance, one might look for patterns and values in the three-fourths of comments that did not concern Scratch projects but were clearly of value to users. Alternatively, one could focus on a particular group of users who stay consistently involved over time or on new users who steadily increase their involvement, (moving beyond just posting a project to commenting and networking with others), looking for patterns of commenting practices that suggest trajectories from peripheral to more central participation (e.g., [30]). Further, with the release of Scratch 2.0 in May 2013, the Scratch site has changed significantly, nearly quintupling in participation by enabling users to program Scratch projects fully online without uploading files. How has this shift changed commenting practices or broader patterns of participation on the site? Finally, one important group of Scratchers are left out of these studies entirely—those who participate in Scratch at home, in classes, or in clubs but rarely become involved in online participation (e.g. [27]). These users cannot be studied online as they generally leave few traces of involvement, but they may identify strongly with Scratch. It is important to remember those who are hidden from view, intentionally or not, in current trends toward "big" data collected online.

Scratch is but one of many kids DIY social networking forums, albeit a particularly promising and popular site. It is also one of the very few designed for kids that explicitly supports coding, collaboration, and commenting with an open-source ethic. Additional comparative research on a massive (or collective) scale may provide broader context for the many deep, ethnographic studies that have identified the learning potential of affinity spaces and social networking forums where youth create, post, and socialize around content. Comparative research across productive sites may further identify more or less successful web designs and leadership structures that can promote agency in user design and collective supports for such agency. As the design of social networking forums is not without its legal and economic challenges, comparative research is also needed on the rights and protections that websites give to users over their self-generated

content, especially to children, as well as privacy rules they apply and funding models they adopt [20].

6. CONCLUSIONS

Our research on the language of youth online peer support is part of a larger effort to understand how these new social networking forums and meeting places can provide contexts for productive and respectful encounters [9]. While there are many sites for kids that support making, large swathes of these sites do not in any way support kids' *sharing* of media or projects. Further, many sites that do allow project sharing often do not include commenting as part of the site design, neglecting opportunities for social feedback, transparency into the creative process, and peer collaboration. Sites like Scratch are relatively rare. In fact, we should not take for granted the actual ability to leave comments on a site even though our findings illustrate that online sites can have positive social interaction and feedback that support kids' learning and identification through the making of relevant artifacts. Through these constructive, informal interactions, they are able to identify ways to improve projects, develop cohesive identity, and adopt various roles, while simultaneously growing in their ability to participate in the digital networked publics.

7. REFERENCES

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8. ACKNOWLEDGMENTS

This material is based upon work supported by a collaborative grant from the National Science Foundation (NSF#1027736) to Yasmin Kafai with Mitchel Resnick, and Yochai Benkler. The views expressed are those of the authors and do not necessarily represent the views of the National Science Foundation, Utah State University, or the University of Pennsylvania. Particular thanks to Anant Seethalakshmi and Andres Monroy-Hernandez for help with gathering data.