

Tools of Play: Coordinating Games, Characters, and Actions While Learning to Play Video Games

Tom Satwicz, University of Georgia, 611 Aderhold Hall, Athens, GA 30605, tsatwicz@uga.edu
Reed Stevens, University of Washington, Box 353600, Seattle, WA 98195, reedstev@u.washington.edu

Abstract: This paper describes an individual's role in coordinating a distributed system for learning. The analysis deals with a core issue for CSCL; the mismatch between common measures for learning, which are based on individual traits and outcomes, and learning processes that are distributed across people and artifacts. Rather than bridge this mismatch through an assessment of group performance, we suggest that learning scientists consider assessing an individual's adaptive reorganization in a socio-technical system. We selected video game play as a context for looking at collaborative learning because it represents an emergent social activity young people commonly engage in. Additionally, recent claims that game play involves deep learning have not been thoroughly investigated with ethnographic research; this project begins to address that gap.

Introduction: Game play as collaborative learning

Empirical research on collaborative learning tends to rely on the traits and outcomes of individuals with the consequence that the accuracy of the collaborative learning process is not well accounted for (Barron, 2003; Stahl, Koschmann, & Suthers, 2006; Stevens, 2000). Although members of the CSCL community have long argued that learning occurs across people and artifacts, assessments still tend to focus on individuals. Broadly speaking studies of activity that take a distributed, cultural-historical, or situated perspective articulate a tension between an individual's agency and the context (Billett, 2006; Latour, 1996). In other words, for the field there is a great deal more to know about how individual agency operates in relation to the broader socio-technical system. Here we approach this issue by looking at an individual's role in naturally occurring instances of collaborative game play. Through a descriptive analysis we argue that the individual's agency plays a role in creating a suitable context for collaborative learning. From the analysis we suggest that one way to think about how to account for learning in the context of collaboration is to look at an individual's coordination of resources, specifically tools. By looking at how individuals coordinate tools we forefront the collaborative process, yet at the same time account for the individual's role.

Data sources and methods of analysis

The data we present here comes from a six-month ethnographic study of young people's game play. The study was conducted as part of a broader effort to understand how people learn across settings such as school, work, and home (Bransford et al., 2006; Stevens, 2000; Stevens & Hall, 1998; Stevens, Wineburg, Herrenkohl, & Bell, 2005). Our decision to study game play extended beyond a specific interest in games themselves. Rather game play was studied because it is how many young people choose to spend their time. Therefore, we find it is important for learning scientists, seeking to understand learning across a range of settings, to investigate this pervasive aspect of young people's lives. Consequently, we use the player rather than the game as the unit of analysis.

Game play lends itself well for looking at naturally occurring instances of collaborative learning. Video games have been held up as holding a promising future for education and the learning sciences (Gee, 2003; Squire & Barab, 2004), however little is known about what young people do while playing video games. The lack of detailed descriptions of game play has contributed in part to divisive debate on whether games are good or bad, rather than a conversation about how young people learn and use video games in their everyday lives. Additionally, many game systems are designed for use in social settings (i.e. the family living room) and come with multiple controllers to encourage use by many people at one time. At the same time, collaboration is not assigned but an emergent activity.

We visited eight participants on a weekly basis in their own homes for six-months. The specific population was chosen to represent a range in age (9-15), gender (4 boys and 4 girls), social configuration (2 sets of siblings, some participants played with friends while others played alone), and the type of games played. The participants selected and played their own games on their own systems, allowing for naturally occurring conditions during field visits. While the participants played, we video recorded activity that occurred in the room where the participants played along with activity that was taking place on the game screen. Later we synchronized the two images, 'in-

room' and 'in-game', into a single file. We then content logged the videos (totaling over 100 hours) with written descriptions of activity across the game and the room. To address specific research questions we used the descriptive content logs to build cases, such as the one presented below. The benefit of having both the in-game and in-room recordings is that a "separate worlds" view of game play is avoided (Stevens, Satwicz, & McCarthy, in press). The separate worlds view holds that games exist apart or separate from other aspects of the players' lives and can lead to an inaccurate picture of how games are learned and their impact young people's lives.

Here we present the play of one individual involved in the study as a case of collaborative learning. "Johnny" was 13 years old when the study took place. He enrolled in the study with his older brother "Mikey" (age 15) and on several occasions (as the analysis shows) the two boys played together. Johnny and Mikey also have a younger sister, "Maddy" (age 8), who played with them and observed their play on a few instances. Johnny was selected for this particular analysis because his play occurred in a setting that involved a great deal of social interaction. Johnny also worked through a defined series of challenges in a particular game during the study period allowing for a view of progression in-game that can uncover the collaborative learning process.

Coordinating a distributed socio-technical system for collaborative learning and play

This analysis illustrates how Johnny gathers a system for collaborative learning. He does this by coordinating people, games, characters, and actions into a tool kit for playing games. *Coordination* is used as means to understand the assembly of people, media, and knowledge for learning and accomplishing tasks (diSessa, 1991; Hutchins, 1995; Stevens & Hall, 1998).

The analysis includes instances that can be seen as collaborative learning; they involve multiple people developing shared meaning while working together on a common problem (Stahl et al., 2006). Here learning is taken as "adaptive reorganization in a complex system" (Hutchins, 1995, p. 289). We use this particular definition to frame the analysis because it does not presume learning as a process relegated only to cognitive activity; "the relevant complex system includes a web of coordination among media and processes inside and outside the individual task performers" (Hutchins, 1995, p. 289). As a concept then, the complex system, or *socio-technical system*, is useful when considering how young people interact with video games and other media that make up the context in which games are played. In addition, we take a distributed view of collaboration, where activity is seen as distributed across people and material objects (Becker, 1982; Hutchins, 1995; Latour, 1996; Pea, 1993).

In the following analysis we describe Johnny's development of a 'tool kit' for accomplishing tasks in video games:

[T]he term 'tool' refer[s] to not only tools in the traditional sense, e.g., objects like hammers, but more generally any socially constituted structure used to accomplish a particular task, including documents and standardized work practices. 'Tool kit' refers to the ensemble of materials deployed for the accomplishment of a particular task. (Goodwin & Goodwin, 1998, p. 91)

Our analysis looks specifically at three tools present in Johnny's play: 'games', 'characters', and 'actions.' Game is used consistently with its everyday meaning; it refers to the media purchased and played on the computer system. Characters are agents in the game, controlled either by the player or the computer, upon which activity is often centered. Actions refer to commands the player gives to the machine for use towards some outcome in the game.

Johnny's tools for play: games, characters, and actions

Take the following organizational setup, present during a field visit, as an example of how people, games, characters, and actions are coordinated in a socio-technical system for collaboration. Throughout most of the visit Johnny sat on the couch in the family's living room with his older brother, Mikey, and his younger sister, Maddy. They played three games during the visit across two different game systems. Some of the games were played concurrently or discussed while another game was being played. Concurrent play was possible because two game systems were present: a console game system played on the family's TV screen and a handheld game system.

The visit started and Mikey was playing *Dragon Ball Z Budokai Tenkaichi* on the PlayStation 2, while Johnny was playing a *Mario Brothers* game on the Nintendo DS handheld game system. After about 18 minutes of play, the two boys switched games. It is here that we can see how labor is divided in the context of their play. At

this particular moment, Johnny was returning to the room after having left to check on dinner. Mikey was attempting to get past a particular challenge in the *Dragon Ball Z* game, where he had to stay alive in a battle against the character Majin Buu until the counter on the screen ran out.

Segment 1

1. ((Johnny runs into the room.))
2. Johnny: She got an all meat pizza] but it wasn't baked yet.
3. Mikey: [Oh! This guy is hard.
4. ((Johnny takes the controller from Mikey.))
5. Johnny: Majin Buu, can I try?
6. Mikey: yeah, I can't survive two minutes.
7. Maddy: he's too tough=
8. Mikey: =now if it was my job to beat him I might be able to do it.
9. Johnny: um ya know that place I couldn't get to earlier?
10. ((Johnny reaches into the couch and pulls up his Nintendo DS and hands it to Mikey.))
11. Johnny: Well it's now open and I'm in it. So run back get the red um, box. Float up, get the red coin on one of the windowsill thingies.
12. Mikey: What are you talking about Johnny?
13. Johnny: There's a red box. ((Johnny turns to look at the Nintendo DS screen in Mikey's hand.)) That!
14. ((Johnny turns to look at the TV screen, which is still loading the game.))
15. Johnny: And the reason he's got Wario's voice is because I'm Wario with Mario's head on. (2 sec.) So just=
16. Mikey: =you just float up here?
17. ((Johnny turns to look at the Nintendo DS screen in Mikey's hands.))
18. Johnny: Float over there.
19. Mikey: [(inaudible)
20. Johnny:]no float more more
21. ((Johnny turns to look back at the TV screen which is now playing an introduction to the battle Johnny will face.))

[Johnny and Mikey 2006-January-06_00:17:38.27]

At this moment Johnny and Mikey coordinated the available tool kit for accomplishing tasks in the two games they were playing. The coordination was preceded by Mikey's comment, "Oh! This guy is hard" (Segment 1 line 3), a statement that indicates he had assessed his own progress a specific task. Johnny then made a bid to take on the task, "Majin Buu, can I try?" (Segment 1 line 5). Johnny included a clarifying question by leading his bid with the name of the character Mikey was attempting to defeat, Majin Buu. The character, to be defeated, then was a part of the tool kit Johnny and Mikey used for defining tasks in the context of play. Mikey agreed to the change by handing over the controller and giving an affirmative verbal response (Segment 1 lines 4 and 6). In this exchange the controller signified who was responsible for the defined task and so it is not only a tool for controlling the game, but an organizational device for marking roles in the room. Mikey also described the parameters of the task at hand--survive two minutes (Segment 1 lines 5-7).

Johnny, though, did not leave Mikey empty handed and literally gave him the Nintendo DS along with a task to complete in the game (Segment 1 lines 9-21). The explanation of the task, however, took several turns and the use of additional tools. Johnny initially described the task with information on where in the game he had been; "ya know that place I couldn't get to earlier?" (Segment T line 9) and "I'm Wario with Mario's head" (Segment 1 line 15). The game characters, Wario and Mario, were used as tools to describe the task. Additionally, actions in the game were used as tools to define the parameters of the task. This occurred when Johnny told Mikey "run back get the red um, box. Float up, get the red coin on one of the windowsill thingies" (Segment 1 line 11). Johnny's explanation included several actions in the game: run, float up, and get the red coin. Mikey however requested additional information (Segment 1 line 12), which Johnny responded to by using Mikey's current actions in the game (Segment 1 lines 13 – 21).

We chose the particular moment transcribed in Segment 1 to illustrate the tool kit that had been coordinated in Johnny's socio-technical system for play. An obvious element of the system is his brother Mikey, who Johnny has enrolled into both his *Mario Brothers* and *Dragon Ball Z* games. The two games played at this moment constitute one type of tool in the distributed system; as seen in the information Johnny passed onto Mikey each game has a

particular local history of play. A second type of tool are the game characters and the degree to which they define play in the game by creating task parameters and are employed to complete those tasks. A third type of tool is actions in the game used to accomplish specific tasks.

Near the end of same the field visit another person was enrolled into the socio-technical system. At the moment, Johnny was playing the *Mario Brothers* game on the handheld system and Mikey and Maddy were still playing *Dragon Ball Z Budokai Tenkaichi*. The phone rang and Johnny's mother brought it to him. On the line was a friend of Johnny's. His mother's description of the activity that was about to ensue was accurate: "They play video games while talking about video games on the phone." [Johnny and Mikey 2006-January-06_01:27:58.29]

Mikey grabbed Johnny's attention during the phone conversation to point out something on the television screen. Johnny then mentioned to his friend that Mikey was playing *Dragon Ball Z* to acquire characters to play with later (see Segment 2).

Segment 2

1. ((Mikey and Maddy are in between battles in the *Dragon Ball Z* game. Mikey points to the screen and gets Johnny's attention. Johnny is playing the Nintendo DS and on the phone with a friend discussing video games.))
2. Johnny: ((Talking to his friend on the phone.)) Woah. Mikey is helping me with um the *Dragon Ball Z* that I got for Christmas and he got me Kid Trunks and all these characters, it's so awesome.

[Johnny and Mikey 2006-January-06_01:29:12.18]

Johnny's comment can be taken as a partial description of the activity in the room, which included collecting characters in *Dragon Ball Z*. Collecting characters or items in games is generally done by completing levels or challenges. In this case, Mikey was working through a series of battles set within a storyline that encompasses the *Dragon Ball Z* game. Johnny's comment, that Mikey got him "Kid Trunks and all these characters, it's so awesome", can be taken as a reference to game characters as a part of a tool kit for play.

At the particular moment, while Johnny was on the phone, at least three other people were a part of the socio-technical system in which he played. His brother Mikey was hard at work, throughout the entire field visit, collecting characters for future play. On the phone was a friend with whom Johnny consulted by sharing knowledge of the games he was playing. His sister Maddy was being apprenticed into the system by acting in a peripheral role to the overall effort in *Dragon Ball Z* (Lave & Wenger, 1991; Stevens et al., in press). Although each person was there to play, they each had a role in adding more game characters and actions to the socio-technical system. By adding characters and actions, the tool kit at their disposal became better equipped for completing a range of tasks.

Within Johnny's social group, access to certain tools, such as actions in particular games, is assumed. Johnny and Mikey described the assumed tool kit in response to a hypothetical question we posed about a friend that needed help with some of the games that Johnny liked to play (see Segment 3).

Segment 3-1

1. Tom: What about you Johnny? Pick out one of your favorite games here, uh maybe the Tony Hawk, was that, you said one of your fav-- Or the *Dragon Ball Z*?
2. Johnny: yeah
3. Tom: If somebody came to you and said ya know, 'I just got it.' Let's say your friend just got it at school or something like that=

Johnny disputed the situation as we framed it and remarked that no one would ask for help on *Dragon Ball Z* (see Segment 3-2 line 4), the game Mikey was helping him with in Segments 1 and 2. He contended that "everyone's already an expert at it" (Segment 3-2 line 6) because five *Dragon Ball Z* games existed prior to the one we asked about. Johnny then likened our question to an older more culturally established game, *Pac-Man*.

Segment 3-2

4. Johnny: =ah, nobody would ask for help on *Dragon Ball Z* though.
5. Tom: Why is that?
6. Johnny: I don't know, cause there's already been five games and everyone's already an expert at it.

7. Tom: mmhum
8. Johnny: And it would be sort of weird. It would be like saying, 'how do you play Pac Man?'
9. Tom: hum
10. Mikey: yeah, it's=
11. Tom: =it's that basic?
12. Mikey: Yeah, really basic fighting game.

The assumed tool kit Johnny and Mikey described includes button sequences, which are used to create actions in the game (Segment 3-3). Mikey held up an older game controller and pointed out how these actions remain consistent, to some degree, across games and gaming systems through conventions built physically into the controllers. Across game systems, controllers take a similar form or in Mikey's words; "every system has this general idea on the right side, it's got a square turned that way." In the case of the game Mikey was describing, each button corresponds to a certain skateboarding action in the game. This indicates that there is an inertia built into the socio-technical system that makes taking up new games easy (Becker, 1995).

Segment 3-3

13. Tom: What about Tony Hawk? Is that the same way?
14. Mikey: [uh Tony Hawk is
15. Johnny:] It's the same for every system and that one's had twelve games for different systems.
16. Mikey: yeah, cause every system has this general idea on the right side, it's got a square turned that way ((Mikey holds up a Super Nintendo controller and points to the four buttons arranged in a square on its right side.)) and this is grid, this is jump, this is special, and this is another special ((Mikey pushes each of the four buttons while he explains what they do in the game.)) And eh- everyone's played a Tony Hawk game once in their life and you've played one, you've played 'em all. The only thing that improves is gameplay and graphics but controls stay the same.

Johnny described how the button sequence used to create an action could change from game to game in the same series. His explanation shows that he had committed to memory two specific sequences to use a "super attack" in the *Dragon Ball Z* games (Segment 3-4 lines 21 and 23). Each of these button sequences is a part of his gaming tool kit.

Segment 3-4

17. Tom: Controls stay the same, is that true across a lot of games you think or?
18. Mikey: uh, [no
19. Johnny:] no because on the original Dragon Ball Z Budokai game
20. Tom: mhun
21. Johnny: it was a side scroller and it was just a basic fighting game like Tekken, so you had to do punch punch punch then energy to do a super attack.
22. Tom: unhun
23. Johnny: but on this one you only have to power up for a few seconds and hold L-one and then triangle to do the super attack.
24. Mikey: yep

[Johnny and Mikey 2006-January-12_00:05:46.12]

Learning to use new tools

Johnny, like many players faced numerous choices within the play of each game. One of the more recurrent activities across games is the selection of a character for use in the game. In Segment 4 Johnny selected a character for use in the game *Super Smash Brothers Melee* (SSBM). At this particular moment he was playing what is called the "events mode" where there are a series of fifty scripted challenges on which a player can work over time. Throughout the six-month study Johnny returned to this portion of the game several times and worked to complete nearly all of the events. The transcript below shows that on one occasion Johnny asked for information on the characters to complete the challenge he had selected.

Segment 4

1. ((Johnny has just completed an event in SSBM. As it finishes he says, "Yes, another one done"))
2. Tom: you're rolling today, hun?
3. Johnny: yeah. Trophy Tussle three. (2 sec.) ((reading from the screen)) here's your shot for ma-joria's mask.

4. ((Selects "Lv. 47. Trophy Tussle 3" and a screen comes up where he must select a character to use in the challenge.))
5. Johnny: hmmm, who can take down many people?
6. ((Selects the character Ness and begins to work on the event.))

[Johnny and Mikey 2005-November-17_01:18:38.13]

Segment 4 began just after Johnny had completed one event and was in the process of moving to another yet uncompleted event (Segment 4 lines 1-4). After selecting an event, he had to choose a character from a group of 25. While he was making his selection Johnny verbally indicated a quality in the character he was looking for, the ability to "take down many people" (Segment 4 line 5). The twist in this particular instance is that Johnny and the researcher were the only two people in the room. While Johnny did on occasion ask for assistance with games from the researcher, it usually took the form of asking if he noticed something that had happened in the game or had access to particular resources (such as the Internet). In general the researcher made it a rule to not offer any help. Additionally, Johnny's intonations and body positioning would indicate he did not direct his comment to the researcher. From this it is inferred that Johnny's request is not to another person, but to himself.

Soon after the moment in Segment 4, Johnny successfully beat the event, something he was unable to do several months earlier indicating that Johnny had made some progress in the game. The question he asked while choosing his character was, however, not new and was present during an earlier field visit where Johnny collaborated with his brother Mikey on the same event. On the first attempt the two boys tried for fourteen minutes and eighteen different attempts and were unable to beat the event. In comparison, Johnny beat the same event in two attempts and two and a half minutes after the moment transcribed in Segment 4. Between the two attempts Johnny changed his character selection. In the instance transcribed in Segment 5, Johnny and Mikey attempted to learn how to use the character, Jigglypuff, to beat the same event Johnny successfully completed two months later.

Segment 5-1

1. Mikey: whoa. (3 sec) I think I'll just stay up here while he's invincible.
2. ((Jigglypuff is floating up at the top of the screen.))
3. Johnny: you only have five jumps and then you're-
4. (13 sec.)

In Segment 5-1 Mikey and Johnny had a short exchange about how to use the character Jigglypuff. Mikey's suggestion was that he would use a particular action, jump, to float on the top of the screen. Johnny then pointed out to him that there are a limited number of jumps that he can use. This short moment points to some variance in how this particular tool, the character Jigglypuff, can be used. As the segment went on, Mikey continued to struggle and asked Johnny for help (Segment 5-2 line 9). The play in this instance also indicates that assigned expertise changes between the boys (Stevens, 2000).

Segment 5-2

5. Mikey: Jigglypuff needs a brick move.
6. (23 sec.)
7. Mikey: This totally stinks they keep putting shells right in the middle.
8. (6 sec.)
9. Mikey: why isn't it working.
10. (4 sec.)
11. ((Mikey pauses the game.))
12. Johnny: Mikey.
13. Mikey: press Z.
14. ((Mikey gets a "failure". The game screen returns to the events menu. The same event is selected; Johnny is now controlling the action on the screen.))
15. Mikey: It just doesn't work.
16. Johnny: That's because you weren't doing the right moves.
17. Mikey: Yeah I was=
18. Johnny: =Mikey you were only doing down B. She's got more moves than down B.

[Johnny and Mikey 2005-September-16_00:05:17.07]

After Mikey asked why Jigglypuff was not working Johnny responded that he was not “doing the right moves” (Segment 5-2 line 15). Johnny’s response points to a particular set of actions, these so-called “right moves”, that are used with the character Jigglypuff. His use of the phrase “right moves” implies that there are also a set of ‘wrong moves’ that should be avoided. These actions (the “right moves”) are a part of the tool kit Johnny has amassed for playing in the gaming context. Segment 6, which occurred just prior to Segment 5 is an example of how the actions of a character were discussed. Mikey had suggested that with Jigglypuff he would be able to kill all of the other characters with one hit, which would have helped them meet the event’s objective (Segment 6 line 2). Johnny disagreed, and contended that the other characters would “wake up too fast” and Mikey countered his point by providing a strategy for using the action (Segment 6 lines 3 and 4). In instances such as this the tools in-hand for the players--characters and actions--were discussed in relation to their utility for particular tasks leading to the development of knowledge for using the tools.

Segment 6

1. ((A battle begins on the screen. Johnny is controlling a character on the screen and fighting a computer controlled character.))
2. Mikey: I need to do that Majora's Mask one cause I know how to kill everybody in one hit. (2 sec) Jigglypuff! (singing)
3. Johnny: They wake up too fast=
4. Mikey: =No you don't even need to make 'em sleep you just get right in the middle of all of 'em and you'll kill at least one with a sleepy attack.
5. ((Johnny switches the game back to the events menu screen.))

[Johnny and Mikey 2005-September-16_00:02:26.11]

Johnny and Mikey's attempt to beat the Trophy Tussle 3 event, partially transcribed in Segment 5, included the development of an action, Jigglypuff’s sleepy attack, for the purpose of completing the event. The development of this in-game action between the two boys occurred early in the study as well. What follows in Segment 7 is an instance of play in which Johnny attempted to explain to Mikey how to use this action while they competed against each other in a multiplayer mode of the game SSBM. Notice that development of an in-game action was a collaborative in-room activity despite the fact that they were playing against each other. This shows one of the ways that unmandated collaborations emerge, through the development of a tool kit for accomplishing tasks.

Segment 7-1

1. ((Johnny, Mikey, and their sister Maddy are in a battle against each other in the game SSBM. Jigglypuff, Mikey's character, spins, lets out a bright flash and is thrown back.))
2. Johnny: Mikey you don't even know how to use it.
3. (8 sec)
4. ((Jigglypuff, Mikey’s character, again spins on the ground, but is thrown across the screen by Zelda, Maddy’s character.))
5. Mikey: Ok, yeah it's official- it's official I don't know how to use Jigglypuff.
6. Johnny: You just hold 'B' and release it. (4 sec.) ((Jiggypuff spins on the ground.)) now release it.
7. Mikey: No I wanted to see her say—

Mikey attempted to use Jigglypuff’s sleepy attack and was unsuccessful (Segment 7-1 lines 1-7). Immediately following Mikey’s try Johnny gave him specific instructions in coordination with the activity on the screen (Segment 7-1 line 7). The sequence points to the coordination of two tools, a character and an action, in an instructional moment.

Segment 7-2

8. ((The battle continues for about 40 seconds.))
9. Mikey: ((Jigglypuff spins on the ground.)) is that how you do it? ((Peach, Johnny’s character, knocks Jigglypuff off the screen.)) no that is apparently not how you do it.
10. Johnny: Mikey you just hold 'B' in and release it. ((Jiggypuff spins on the ground starts flashing and Zelda flies off the screen.))(3 sec) there you go.
11. Mikey: ohhh

12. Johnny: yeah, who would have ever figured out that
[Johnny and Mikey 2005-July-14_00:48:50.01]

The instructional sequence transcribed in Segment 7 ended with Mikey successfully completing Jigglypuff's sleepy attack. The instance is a glimpse into how characters and actions become tools for use in the play of video games. Particular tasks not only require a tool kit that contains the right characters and actions, but knowledge of how to use the tools. Although Mikey and Johnny were competing against each other at the particular moment they both collaborated in building the socio-technical system. By helping Mikey develop as a player, the tool kit Johnny used for playing games was distributed across multiple people.

The collaborative development of a new tool

Johnny also worked collaboratively with players other than Mikey when developing his set of actions. On a different date Johnny and a friend, Evan, developed an action in the game, *Teenage Mutant Ninja Turtles 2: Battle Nexus* [Johnny and Mikey 2005-August-19]. The action was developed to solve a specific problem the two boys were having. During the course of their play Johnny and Evan were given a challenge by the game in text; "Take Fugitoid to a secure place. Just pick it up and carry it with you. It won't be a nuisance that way. There's a way out from the rear of the back street." Johnny and Evan struggled with this task because they were unable to figure out how to pick up Fugitoid as the directions indicated. The struggle was the result of a missing action in their tool kit.

While figuring out how to carry Fugitoid the boys introduced a variety of actions into the socio-technical system. These actions include: moving forward without Fugitoid, pushing Fugitoid, and throwing Fugitoid. Some of the actions partially worked but none of them lead to a successful completion of the task. Johnny and Evan also attempted to introduce resources external to the game into the system to help figure out how to pick up Fugitoid. These resources included: the researcher as a knowledge source, the Internet, and a guidebook. None of the resources were immediately available so the boys continued on without them. Eventually Johnny threw Fugitoid in what might be considered an "accident" or "random" occurrence, however at the moment Johnny was going through the possible button combinations. These combinations are limited by the physical nature of the controller.

Segment 8

1. ((Johnny's character moves away from Fugitoid and Evan's moves in closer.))
2. Evan: Did you press all the buttons?
3. Johnny: ye:::s. I tried every single combination of buttons
4. ((Johnny is pushing systematically through the buttons on the controller. His character is at the front of the screen and responds to each of the button combinations.))
5. Johnny: (2 sec.) wait I thought I- (4 sec.) darn I thought that was grab (4 sec.) I had it for a second.
6. Evan: what? pick up=
7. ((Johnny's character bends down slightly as though he is going to pick something up.))
8. Johnny: =there!
9. Evan: what is that?
10. ((Johnny's character moves towards Fugitoid and picks him up briefly, flipping Fugitoid over his back.))
11. Evan: Oh you flipped him. How'd you do that?
12. ((Johnny's character picks up Fugitoid and carries him on his back.))
13. Evan: Yes. How'd you do it?
14. ((Johnny's character throws Fugitoid over a ledge towards their final destination.))
15. Evan: There we go, how'd you=
16. ((Johnny pauses the game.))
17. Johnny: You hold L and press B or A I can't remember
18. Evan: ok hold on, let me try.
19. ((Johnny's character flips Fugitoid over his back.))
20. Evan: Hold L=
21. Johnny: =push A
22. Evan: I'll do it I'll do it (3 sec.)
23. ((Evan's character is next to Fugitoid, but he is not picking him up.))
24. Evan: I can't do mine
25. Johnny: Hold L- get out of the way.

26. Evan: maybe it's B (inaudible) I'm not gonna be able to do it.
27. ((Evan's character goes up to fight the attackers. Johnny's character goes and picks up Fugitoid.))
28. Johnny: R
29. Evan: R? R and what?
30. Johnny: R and B
31. Evan: 'k just=
32. Johnny: =I'm carrying him
33. Evan: just keep walkin. pick him up again. I'll protect you.

[Johnny and Mikey 2005-August-19_00:25:27.09]

In Segment 8 there are several relevant moments to the development of the tool kit used in their game play. Lines 1-9 include Johnny's attempt to systematically find a new action, ending with the recognition that something significant had happened; "there!" After Johnny and Evan recognized that a new action could be used to accomplish the task they refined it (Segment 8 lines 10 – 27) and committed the button sequence to memory (Segment 8 lines 28 – 33). In this particular instance Johnny and Evan learned a new action by using their existing tool set, including the inertia present in the conventions of the controller. They then coordinated the action with other aspects of the socio-technical system to accomplish an emergent task.

Discussion

The analysis here looks across Johnny's play to understand how one accomplishes the work of playing a video game. Johnny's play includes the development and coordination of tools for use in a socio-technical system. The tools are means by which he interacts with the game to accomplish a set of emergent tasks. Johnny's success in solving game tasks is a result of his adaptive reorganization in the socio-technical system over time. This description of collaborative learning is a case of tool coordination—games, characters, and actions—for use across people within the system. The descriptions are useful for thinking about how to understand an individual's role in a collaborative effort.

Learners like Johnny adaptively reorganize tools in the system by bringing multiple disparate elements into coordination (Stevens & Hall, 1998). In this case, Johnny expanded his tool kit and developed the knowledge required to use the new additions. This reorganization occurred across both people and artifacts. Some of the actions Johnny committed to memory, while characters remained saved in the game system. What should be recognized is that in many of the instances there was an emergent self-assessment of the tool kit that led to a reorganization of the system. Johnny and his collaborators looked at what was and was not working. They also took feedback from the game system and each other. For example, take the instance above in Segment 1 when Johnny and Mikey switched games. At that moment, Mikey's comment, that the task was difficult, set the stage for a reorganization in which Johnny took over one task while handing another over to Mikey.

Learning as reorganization in a socio-technical system has potential if we can document instances where tools are developed in the pursuit of tasks meaningful to the learner. It is easy to see the activity Johnny was engaged in as a non-consequential despite the ubiquity of game play. However, his coordination of tools towards accomplishing specific tasks is remarkable. It involves a network of people whose assigned expertise changes on a moment-to-moment basis (Stevens, 2000). The coordination makes use of an inertia (Becker, 1995) built into the media and other objects; however, players such as Johnny create their own tools for working within this system. Tasks emerge from use of the tool kit, rather than an externally mandated source. Additionally, the collaboration was not mandated, rather it was a function of how tools were coordinated to accomplish the emergent tasks.

This suggests that accounts of learning in collaborative settings might benefit from a component that evaluates an individual's reorganization of the socio-technical system. This echoes some of the ideas behind Preparation for Future Learning assessments, where the focus is not whether an individual is able to immediately solve a problem in a new setting but on how well the individual is prepared to learn how to solve new problems (Bransford & Schwartz, 1999). However rather than focus explicitly on cognitive processes inside the head, the description above indicates that the development tool kit is an aspect of how one learns in a collaborative setting.

One point that should not get lost here is that the learning in these instances is not programmed or designed into the media. It was an active process where the participant developed a tool kit for working and learning in the context of games. This is consistent with the perspective Suchman (1987) articulated in regards to help systems built

into copy machines; that AI systems are a resource for action rather than a programmed plan. In Johnny's case the programmed aspects of the game were tested against his conception of how the coordinated tool kit worked. When progress was not made on the task at hand, he reorganized.

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Acknowledgements

This work was supported by a grant from the National Science Foundation (NSF#0354453). Any opinions, findings and conclusions expressed here are those of the authors and do not necessarily reflect the views of the NSF. We also want to thank Laurie McCarthy for her role in the Gaming to Learn project, along with Lari Garrison and Heather Toomey Zimmerman for reading earlier drafts of this paper.