The Stamp Plate and the Kicking Chair: Data Play for Mealtime in Preschools

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ABSTRACT
Most technology designed for young children at mealtime centers around conceptions of how the child should eat or behave at the table. Expanding this view to include children's perspectives, we present an evaluation of three prototype technologies for mealtimes in preschools. Building on our past work to identify value tensions between adult caregivers' and children's perspectives at meals, we evaluated the prototypes to address different tensions in this context (for example, the tension between children's interest in experimenting with food versus the teachers' interest in cleanliness). Results of our user study show one of our prototypes (the "stamp plate") facilitates self-tracking and creative play for children, while another (the "kicking chair") encourages play but distracts and detracts from the meal. Although there are specific ways adults' and children's values are at times in conflict, our results suggest the potential for novel forms of *data play* that offers meaningful experiences with technology for both parties.

Author Keywords
Child-computer interaction; Tangible User Interface; playful technology; Designing for children; data; value tension.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Meals are a necessary part of any full-day preschool program; teachers and administrators must plan and facilitate meals, and children must engage as active participants. The overt purpose of any meal is to provide nourishment, but meals also serve to socialize children in the practices and values (i.e., family, culture) of their community [1]. Meals offer opportunities to bond and socialize [2], and across cultures, sharing meals is seen as a sign of friendship [3]. Prior work has shown that meals are an important social and learning experience in schools in particular [2,4,5].

Technology designed for this meal contexts can shape children's behaviors and attitudes toward food and play a role in defining their mealtime experience. For example, persuasive apps [6] and augmented reality applications [7] have each been shown to be an effective medium for reducing picky eating habits. To date, the majority of the work in this design space has explored how technology might nudge children toward pre-defined societal norms, such as adopting healthy eating habits, understanding nutrition, trying more foods, or eating larger portions (e.g., [8,9]). However, less is known about the tensions that exist between the expectations of adults and children when it comes to mealtime technologies.

In this project, we evaluate three prototype technologies for children's meals that elevate children's perspectives and values in addition to considering those of adults. Some prior work suggests that imposing adults' attitudes on children can have a negative impact on children's eating habits, for example, diminishing their ability to self-regulate and listen to their own hunger and satiation cues [10]. And a large body of work in child-computer interaction has shown that moving beyond the conceptualization of the all-knowing adult and including children's perspectives in the design process is a valuable means of creating technologies that best serve their needs [11]. Thus, in past work, we conducted observations to identify conflicts between teachers' values and children's values in mealtime contexts [blind for review]. We then explored how we might design tools that are sensitive to both teachers' and children's needs and sought to help resolve inherent tensions in their perspectives.

We build on this foundation to evaluate prototypes to address these tensions. For this study, we asked children and teachers to evaluate three novel prototypes, which we called the "cat fork", the "kicking chair", and the "stamp plate". We designed each prototype to address a different value tension we identified through our observations and interviews with children. The cat fork was intended to support children's autonomy while also encouraging children to use utensils. The kicking chair was designed to provide children with fun and playful feedback as they wiggled at their seats, thus incentivizing them to stay at the table while eating. Finally, the stamp plate was designed to account for children's sensory needs while simultaneously encouraging them to

keep their food on their plate to reduce the mess they created while eating.

We conducted testing sessions in the lab with 12 preschoolers and 7 teachers to evaluate all three prototypes. Feedback from both children and teachers suggests the prototypes shaped children's mealtime experience by encouraging increased food consumption, consistent utensil use, and distraction. Children engaged with the aesthetic form of mealtime as much as the productive work of eating to keep their bodies healthy. Our analysis suggests attending to the expressive potential of digital traces of activity, a concept we call *data play*, as a promising design space for developing technology with and around children.

RELATED WORK

Designing for Children and Meals

A number of prior studies have explored the design of technologies for children's meals. This work has focused on designing tools to facilitate healthy habits, such as apps and games to reduce picky eating habits [7], help children distinguish healthy foods from unhealthy ones [12], or foster awareness and self-reflection about healthy eating [13]. For example, Educatableware is a pressure-sensing fork-and-cup set designed to persuade children to eat healthy food [8], and Healthy Spoon and Healthy Cradle are part of a smart flatware set to encourage children to eat vegetables [14]. Other work has leveraged user-centered design practices to create smart objects for meals that support children with developmental disabilities who struggle to use traditional utensils [15]. These studies and others demonstrate that technology can play a valuable role in children mealtime experiences.

Many of these studies and others have involved children in the design process or explicitly designed to facilitate playfulness and make the user experience enjoyable for children. Here, we build on this prior work by exploring what it looks like to make children's interests more than a means to engaging them in another end (e.g., healthy eating) and instead to support children's interests and values as a design goals in their own right. Designing to encourage healthy eating habits is certainly a worthy undertaking; here, we wanted to understand whether there are also underexplored design opportunities in this context that might become clearer by valuing children's goals as equal to those of adults.

Meals in Preschool Classrooms

A number of studies have examined meals and meal-related interventions in preschool with regard to their nutritional value. Prior research has found that even marginally food insecure children have trouble performing well in school [16], suggesting that it is important to ensure that children are well-fed in the classroom. Other research has examined the social characteristics of classroom meals, for example, demonstrating that meals provide children and teachers with the opportunity to engage in extended conversations [2], and that the quality and quantity of teacher-child interactions are greater during meals than during other semi-structured classroom activities [5].

Although we are not aware of any prior research to design digital technology for this setting, several studies have examined the design of the classroom environment for its impact on meals. For example, Snack Talk cards—pictorial flash cards with child-preferred topics—have been shown to increase social conversation during meals in inclusive preschool classrooms [17]. Other work has shown that the design of mealtime structure can influence children's behaviors and interactions. For example, serving food family style can increase the incidence of preschoolers' meaningful participation in social aspects of the meal [18].

Other work has examined the design of digital technology for activities in preschool classrooms that are unrelated to meals or eating. A number of apps have been designed to teach preschool math concepts in classrooms [19]. Westlund and colleagues found that robots in the classroom can increase inclusion and provide opportunities for social learning that teachers are excited about [20], and in a long-term classroom deployment in preschools, Sylla demonstrated the Touch-Organize-Create system can scaffold the development of literacy skills [21].

Together, this body of work suggests that: 1) meals are an important part of the preschool experience for basic nourishment and social acculturation, 2) the design of mealtime structures, activities, and tools can shape children's and teachers' experiences during the meal and the value they derive from it, and 3) thoughtfully designed digital experiences can play a positive role in classrooms. Here, we combine these related strands of reach to explore design opportunities for classroom meals.

Value Tensions

Value tensions refer to instances in which two important values are in conflict in a given situation [22]. A number of studies have examined such conflicts as a part of the design process. Yassaee and Winter identified a number of value tensions in the design of health-surveillance technologies for the workplace, such as the conflict between privacy and well-being and the conflict between work and leisure [23]. Miller and colleagues examined conflicts related to privacy and reputation in a groupware system and demonstrated that value-sensitive design practices can successfully address these tensions [24].

Many prior studies have shown that examining value tensions can be a productive framing for contexts that involve children and the adults who support them. Existing research has identified tensions between academic success and personal fulfillment [25], children's autonomy and online risk [26], the need for play and the need for safety [27], among others. Given that the purpose of this project was to better understand and design for children's values while continuing to support the values of teachers, we built on this prior work by examining value tensions in the context

of preschool meals. By examining these tensions within a context that is both communal and necessary, we contribute towards the development and understanding of these tools in promoting health and well-being in families.

METHOD

We recruited twelve 3-to-6-year-old children to participate in our study via email lists at our institution and at local family housing communities. There are 5 boys and 7 girls in the study. Because we wanted to test how children reacted to the prototypes before going into large preschool classrooms with many children, we tested the children individually.

We also recruited seven preschool teachers to evaluate the three prototypes and participate in a semi-structured interview about the feasibility and usefulness of each of the prototypes. *[Sentence about teacher demographics or info about the school.]* All parents and teachers received a US$30 Amazon gift card as a thank-you for their participation.

Materials

We asked children and teachers to evaluate three novel prototypes, which we constructed through observations, sketching exercises, and user interviews. Each of these three prototypes is described below.

Cat Fork

The cat fork (see Figure 2) comprises a fork and plate (each resembling a cat's head). When the fork meets the plate, it causes different parts of the cat's face to light up (10 different color lights illuminate the cat's eyes, nose, whiskers and mouth). We designed the prototype to encourage children to use utensils while maintaining their autonomy. The illuminating effect on the plate provides children with immediate positive feedback, encouraging them to touch the fork with their own plate rather than touch the table or pick up other children's utensils. The prototype is built with an Arduino board and a Makey Makey [28].

Stamp Plate

The stamp plate (see figure 3) consists of a stamp that leaves behind shadow-like shapes that correspond to the food that children eat off their plates. As the child eats, the stamp plate keeps track of the food that has been eaten and displays silhouetted figures that resemble that food on the plate, eventually creating a graphic montage. A goldfish cracker, for example, leaves behind the shape of a small fish. We designed the plate to account for children's sensory needs while encouraging them to keep food on the plate and reduce mess while eating. For our study, we simulated the design concept by having a researcher use pre-made custom stamps with multi-color inks on a separate plate every time the child picked up a snack and ate it.

Kicking Chair

The kicking chair (see figure 1) comprises a long elastic band attached to the front to chair legs that produces sound whenever the child kicks it. We designed the object to give children playful and unexpected feedback when they wiggle at their seats, encouraging them not leave the table while eating. The elastic band can be detached and reattached to any chair. For our study, we implemented this concept with two folded pieces of aluminum foil attached to a rubber band and connected to a Makey Makey board and a laptop. Every time the child kicked the rubber band, the two pieces of aluminum foil touched and triggered a piano note to play.

RESULTS

Discovering of Affordances

As children encountered the objects for the first time, most of them took some time to understand how each of the three prototypes worked. In some cases, children understood the prototype right away, for example, KD explained "*I want a fish here,*" as he pointed to the stamp plate and then ate a fish from that spot on his own plate. Other children immediately pointed out the connection between the triangle stamp and the chips (e.g, KI) or the half circle to the apple (e.g., P1).

In other cases, children did not immediately discover the prototype's affordances. Many children did not understand how the kicking chair worked even as they used it to produce noises, and in these cases, children claimed the computer, the wire, or the chair itself was responsible for making the instrumental sounds. Eventually, most children came to understand how all three prototypes worked, although occasionally children developed unexpected mental models, such as believing the stamps on the stamp plate represented images of food that other children had eaten (KN).

Once children understood the prototypes, their reactions varied. Some continued to explore the prototype and ask questions, while others focused on eating the food. When children liked the prototype, it was often quite obvious, and they responded with exuberance. KF and KT responded to the kicking chair by giggling hysterically each time they heard the sound it made. KG checked the light on the cat fork and plate as she took a bite carefully and beamed when the light came on. She commented: "*when more lights are on, it [the cat fork] is happier!*"

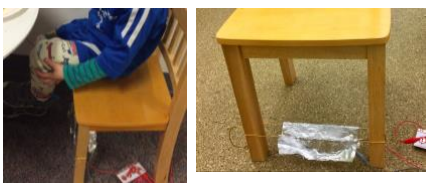

Figure 1. Left: Kid giggles while using kicking chair, Right: kicking chair.

Figure 2. Left: Child tries to pick up a pretzel with cat fork, Right: cat fork prototype.

Figure 3. Left: Child looks at the stamp plate to count the goldfishes he's eaten, Right: stamp plate prototype.

Influencing Children's Behaviors

We observed a number of systematic ways in which children's behaviors changed in the presence of the prototypes. Here, we describe some of the cross-cutting ways in which the prototypes appeared to shape children's choices and actions.

Increased Eating

Parents expressed that both the cat fork and the stamp plate led children to eat more food during the study session. KG's mother commented several times on how much more her child was eating during the session than usual. And after the study, she remarked: "*Oh my baby ate so much more. Actually, more than what she eats in a whole day!...I hope we have all these (objects) at home."* In another instance, P1 kept eating many goldfish crackers and pretzels to produce stamp artifacts for these items.

The cat fork also led children to eat more. KM wanted to know if the plate made sounds, and he started to eat more from the plate to explore the plate's capabilities and the effects of eating. KD's mom claimed the cat fork caused her child to eat much more because he liked using it. Another participant, KG, ate very intently using the cat fork until all of the food was gone. The children tended to keep their attention on the meal while using the cat fork.

We asked our child participants which prototype they liked the most at the end of the study, and we asked if they would eat their least favorite food if they could do so using their preferred prototype. While some said they would not, others said they would eat a bell pepper or cheesecake (a non-preferred food) to produce stamps on the plate. KF said she would eat broccoli to make the cat fork's plate light up. KD asked for more crackers because he wanted more circles on the stamp plate. And a few children who said they were already full before testing the third prototype still finished the third snack. Parents commented on the amount children ate throughout the session, saying things like, "*She was certainly paying attention to what was happening...that certainly had an impact. She's certainly eaten a lot"* (KF).

Increased Use of Utensils

We observed that when using the cat fork, children were more willing to use their utensil to eat. Children were encouraged to explore the fork initially but were not required or continually asked to do so. However, many children continued to engage with the fork and the lights as they ate, even using the fork for snacks that are typically eaten as finger foods. P2 loves cats and when using the fork to eat an apple slice, she said: "*Guess what? I've never used a fork to eat an apple.*" KF used the fork for every bite on her plate. And several children tried to use the fork to eat goldfish crackers or tortilla chips. A few participants gave up on using the fork to eat these challenging foods after several attempts, but most of them switched back to using the utensil when they ate cheese cubes or bananas slices, which were easy to stab.

In our original field observations [blind for review], we saw children "half using" utensils while eating; that is, using their hands to pick up food and put it onto the utensil before putting it into their mouths. Children performed this same action when using the cat fork. Although we designed the object in part to address this behavior, we saw that children continued to maintain it when using the prototype.

Increased Distraction

While the cat fork and stamp plate tended to encourage children to focus on their utensils and their food, the kicking chair routinely redirected children's attention away from eating and toward the prototype. Although some children giggled and seemed to enjoy making sounds at the table as they ate, most of the time children either ate or played with the chair, but did not integrate the two behaviors. For example, children sometimes squatted down and used their hands to make sounds, and some alternated between sitting while kicking and sitting while eating.

One child (KF) explicitly stated that the object was a distraction and explained that she was going to use the kicking chair to distract her dad so she could steal his candy. She went on to say she would use it to distract people in public places. KD even believed he should not use the kicking chair during meals. He played with the chair for a bit initially and then politely asked the researcher, "*Can I eat now?*"

Creative Exploration

We observed that participants engaged in creative exploration when using the stamp plate. P1 intentionally continued eating in order to see the image the resulting artifacts would form on the plate. KD wanted a goldfish on a specific spot on the stamp plate, therefore he ate one from the analogous location on his food plate. When we asked why he wanted to eat the goldfish at that specific spot, he explained: "*because I want the fishes to pile around*."

Children also made creative comments as they looked at and reflected on the stamp after the meal. They made sense of the shapes of the food and created their own stories, which they retroactively fit onto the images they had produced. For example, KF explained that she had made a pretzel maze for a goldfish to swim through. She went on to describe how she would make a maze using the plate in the future, saying, "*I would turn the plate in the direction I wanted the fish to go in.*" KD also described his stamp plate as a scene deep under the sea, saying that the triangles are sea plants, the circles come from people dropping balls in the sea, while the fish are trying to help give the balls back to the people.

Prompting Self-tracking

When using the stamp plate, several children spontaneously engaged in tracking their food intake. We did not ask the first few children how many pieces of food they had eaten, but we observed that they proactively counted the fish stamps, the triangles, and circles as they were eating and we were stamping. After we observed this behavior in multiple

sessions, we modified our protocol to include asking children how much they had eaten. Most children easily linked the composition of the stamp plate to the food they had eaten. For example, when asked how many tortilla chips he had eaten, KJ counted the triangles on the stamp plate and responded correctly.

A two-year-old participant even reminded the researcher that he had eaten a cracker and that the researcher had not yet placed a corresponding stamp on the plate. Many children similarly pointed to missing stamps if the researcher had yet to stamp the plate, suggesting children found the link between eating and the immediate effect that followed to be meaningful.

Teacher's Responses to Prototypes

Teachers' and children's reactions to the prototypes were mostly well-aligned. Here, we describe teachers' general impressions of each of the three prototypes as well as themes that emerged across all of them.

General Impressions of Each Prototype

Cart fork: teachers predicted the cat fork would help children develop fine motor skills and encourage them to use utensils. Some teachers felt the cat fork may be more appropriate for younger children (under the age of 3) who are learning to use utensils for the first time. A few teachers worried the lights on the plate could be distracting for children and anticipated that children might poke the plate with the fork persistently to see the light.

Kicking chair: all teachers loved the concept of the kicking chair and thought it was innovative and likely to be engaging for children. However, they did not feel it was appropriate for mealtime and envisioned using it during playtime when it could be the focus of the activity. They predicted 20 children making noise while eating would be chaotic, and a couple of teachers said they already struggle to prevent children from kicking each other's chairs at mealtime.

Stamp plate: almost all teachers felt that the Stamp Plate would encourage children to try new foods and would generate conversation at mealtime, and almost all teachers said that conversations with children are what they value most about meals. For example, PT1 anticipated that children would have conversations with her about how and where the food is placed on the plate. She explained that she could model placing the food, such as putting a goldfish on a plate next to a piece of cheese, and the children might put another goldfish on the plate, this time above the cheese, or to the left of the cheese, fostering conversations about spatial relationships.

They also appreciated the Stamp Plate's support for children's creative expression. PT7 commented that she thought the resulting images that the foods left behind on the plate, and the artistic form it would take, could generate many new conversations in the classroom.

Teachers Regulating and Facilitating Use of the Objects

Most teachers mentioned the need for some regulation and modeling with respect to children's use of the objects. PT4 said she would show children how to use the Smart Plate and talk to them about how it works. PT7 envisioned using the class' circle time prior to the meal to explain the stamp plate and caveats to its use. She emphasized that it should be used as a tool to help children understand what they are eating, not as a toy or something to play with. PT4 also said she would demonstrate how to use the cat fork, explaining how it works and linking it with nutrition. PT2 said he would regulate use of the kicking chair by coordinating and letting children take turns kicking. PT7 also mentioned that if she were to use the stamp plate in her classroom at mealtime, "*there would have to be some sort of caveat. If we are truly using it for their food during meal times for them to eat with, that it's not just a toy or something to play with, but it is a tool to help them get to see what they're eating.*"

The Mealtime-Playtime Dichotomy

Teachers had strong opinions about separating playtime from mealtime, and they explained that they wanted this dichotomy to be salient for children. PT3 commented on the kicking chair, saying: *"mealtime is when kids know they've finished playing, and it's a time to practice table manners and learn about food."* PT5 and PT7 made similar comments when speaking about the Smart Plate. PT5 said the illumination and animal features are more appropriate for playtime. She explained that she views mealtime as a time for children to converse with friends and practice engaging with food served family style, instead of focusing on their individual plates. PT7 explained when commenting on the cat fork: "*one of our guidelines at our meal times is that the meal times are for eating, and they're for getting your nutrition and giving your body the energy that it needs. And so, focused on eating, and it's not about playtime.*"

In this session we compare teachers' beliefs about how children will react to the prototypes with children's reactions in practice, drawn from our observations during user tests. Although this observational data cannot represent the range of experiences that might unfold in everyday life, we find rich impressions of mealtime engagement emerge as we consider the connections and discrepancies between the expectations for the prototypes and the prototypes in practice.

Cat fork: teachers expected the illuminating parts of the smart fork to meaningfully distract children form their meal. While a couple teachers acknowledged the lights in the plate could direct children's focus to the plate, more teachers thought the light would encourage children to focus on playing with the plate, instead the food itself. T1 said: *"it would be a bunch of kids hitting their plates, and then really causing food to kind of go everywhere."* Other teachers imagined that a cat plate with a cat fork would prompt children to fight with each other at the table, more than with a regular fork. They were also concerned that focusing on the

plate would take children's attention away from conversations with others.

In the test sessions we did not observe the cat fork distracting children from their eating. On the contrary, most children were pleasantly surprised to discover that the cat plate illuminated. They ate tentatively with their forks to pick up the food on the cat plate, paying careful attention to which part of the cat plate lit up. Some of the children even used the fork to pick up pretzels (a food commonly eaten with hands). However, we tested with children individually, which prevents us from learning if they would fight each other with the cat fork.

Stamp plate: children's reactions to stamp plate show correspondence with teachers' expectations across the board. Teachers imagined children would make connections between the food they ate and the images left behind on the plate. In practice, children were able to make the connection between the food and the corresponding stamps. Teachers also thought the plate would encourage children to try new food which they normally would not. During lab tests, children expressed willingness to eat food they didn't like in order to have a stamp appear on the plate. Lastly, teachers expected the plate to help regulate mess and encourage creativity at mealtimes. While exploring the plate, children in our lab test all kept their food on their plates and demonstrated creative thoughts from the stamp-imagery they prompted by eating.

Kicking chair: it is another prototype that the perceived behavior by teacher corresponds with how the children react to the plate. Distraction is a major concern for teachers and the testing it with the children shows the same. Children would kick and laugh so happily and completely forget about eating; another boy was constantly trouble shooting to see why the kicking chair does not work and also forgot about eating. In addition, teachers think the kicking chair will further decrease the distract conversation at mealtimes. In fact, teachers love the kicking chair idea but they think it would be more appropriate to use it other than the mealtime. For example, a couple teachers mention they can use it in a musical and communal circle time to promote conversion and musical engagement, just not at mealtimes.

One of the limitations to our work was that we test with the children and get children's feedback separately.

DISCUSSION

Children and adults exhibit distinct goals around meals and mealtime behaviors that, at times, are in direct conflict [add description]. Here, we saw that our prototypes eased several pre-specified value tensions, while surfacing new ones. For example, in developing the kicking chair, we wanted to acknowledge children's need to wiggle at the table while simultaneously supporting the adult's need for an orderly environment. However, both children and adults explained to us that the chair distracted children from eating and created more chaos for teachers in the classroom. Although the kicking chair addressed the values we set out to support (i.e., facilitating wiggly play while keeping children in their seats), it introduced new tensions wherein: 1) children valued attending to the chair and adults valued children attending to the meal, and 2) children valued using the chair as an instrument while adults valued a quiet environment that is conducive to conversation. We saw how teachers repeatedly stressed keeping creative play separate and distinct from mealtime, such as PT7, who referred to eating by saying that it is, "*not about playtime*." The illumination and animal features of the cat fork, for example, seemed to distract from the task of children feeding themselves a healthy and nutritious meal. Our work highlights the complexity of children's mealtimes as a context for interaction design precisely because of this unexpected twist: while trying to address one tension, designers may create others.

We also saw that it was at times difficult to untangle whether our designs fostered behaviors that resolved tensions for all parties or resolved the tension for one party while raising new concerns. For example, we saw many indicators that our prototypes incentivized children to eat more than they normally do, opening serious questions around childhood obesity and the danger of encouraging eating while not hungry. While our lab study controlled the quality and quantity of snacks, we still observed uneven eating habits with some kids eating more goldfish than cheese cubes, for instance. Although encouraging children to eat more food aligned with adults' goal of children focusing on their food, we do not yet know how children feel about this change in their own behavior nor about its consequences beyond the contained lab study. If children's tendency to lose focus on a meal as they eat is a result of their own hunger and satiation cues, then our prototypes might prompt children to maladaptively eat beyond their own limits and ignore their internal cues. However, if children's tendency to lose focus on food is a result of a competing need for play while they are still hungry, then our prototypes offer a mechanism for supporting both needs simultaneously. Our results suggest that the long-term effects of the stamp plate depend in a large part on the circumstance around it: what food sits on plates, the duration of time available, the conversations in which its embedded.

Data Play: Mealtimes as Sites for Expanding Expressivity

The stamp plate in particular suggests the potential for designing technology around mealtime expressivity, a notion we refer to as *data play*. During our lab tests, we observed children use traces of their eating behavior to invite creative storytelling and reflection at the table (see "designing with traces" paper for related approaches). Children counted and kept track of their food in creative and playful ways, an impulse that suggests not only designing for how children should act or eat at the table but also for the ways children use mealtime experiences as sites for exploring the expressive potential of data provenance. Drawing from our study, we find designing for data play involves encouraging children to make meaning, explore, and play with their data

without setting fixed goals or using traditional notions of productivity.

Returning to the design process, data play prompts us, as designers of technology, to consider what we do when we seek to address value tensions. Value tensions, through this view, invite not quick resolution but a kind of slowing down of our analysis to invite moments of surprise or whimsy. Our study suggests that we examine how values get aligned or opposed in and through practice, exploring in what ways values work as more than discrete, fixed preferences such as those attributed to teachers and students. After introducing our prototypes we learned of new unforeseen alignments (such as the enjoyment with data provenance) and vivid tensions (such as reorienting the child's attention) that were hard to surface during observations and interviews alone. When we examine data play as one of many practices that emerge within the context of children's mealtime (prompting the exploratory production of images with eyes, hands, and mouths), we deepen our understanding of how value tensions work as processes. Data play (as embodied in the stamp plate) thus represents one avenue for harnessing children's interest in noticing the world around them in new ways, while simultaneously using their attentiveness to accomplish everyday life tasks such as eating.

Future Work

To further investigate how young children make sense with their own data, we have developed a version of the stamp plate for future deployment (Figure 4). To enable the plate to display a stamp on the position where the child picked up the food, we need to implement a mechanism which could sense 1) the child has picked up the food from the plate 2) the type of food they picked up. We have tried several approaches to enable such interaction, one was through using a computer vision approach to sense the food type and position on the screen. However, this approach requires us to set up an external camera, which requires extra calibration and might be affected by shading and other external visual factors. We tried several approaches to enable such interaction. One of them was to use an object tracking approach to identify the food and location on the surface. However, most object tracking techniques require additional tags to be attached to the tangible objects. For example, for visual-based tracking, tags such as ARTag [29] or QR code[30] would be added to the object. Other sensing techniques like electromagnetic sensing[31] also requires attaching additional circuit to objects. In our case, adding additional tags to food would make it inedible. We intend to have this device used in real world settings instead of children come into lab using it, and devices with cameras are not as versatile in communal settings such as mealtimes. Therefore, we decided to have a tablet connected with a weight sensor. The touchscreen could be used to sense if the child has picked up the food from the plate. The weight sensor is used to sense identify the type of food the child picks up. The way to achieve it is we preprogram the food provided to the children and cut the same food item with the exact same weight. We use an Arduino Uno and a set of load cell with amplifier HX711 to transfer the signal to the Android tablet (Samsung T280 with a 7-inch screen). Considering the different forces of each touch and the minor differences between each food items, our current design limits us to only provide 3 different types of food for an optimized result. Each of the food holds a different given weight which differs by at least 2g. The food items are distinguished by its color, shape, and weight. They are apple slices(10g), cheese cubes(5g), and bread slices(1g). The food items are placed on tablet screen and the child picks up the food from there. The food is conductive. Touching the food on the tablet surface triggers a touch release action which triggers the system to start counting the weight change and displays the food stamps on the screen.

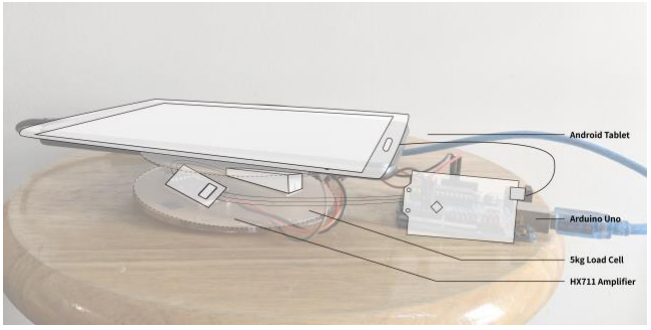

Figure 4. Stamp plate prototype.

CONCLUSION

In this paper, we a conducted user study with children and teachers to gather their feedback on three prototypes designed to resolve adult-child value tensions in mealtime contexts. Our results show that although our prototypes addressed certain value tensions, they seemed to ignite new ones, highlighting their enactment through practice. Our work further suggests attending to data play, exploring the expressive potential of digital traces of activity, as a fruitful design space for developing technology with and around children.

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