Multimodal participation frameworks during young children's collaborative drawing on paper and on the iPad

Abstract

Due to its distinct affordances, the iPad might foster alternative forms of collaborative creativity when compared with pens on paper. In this article I examine how a collaborative drawing task among five pairs of 5-6 year olds unfolded on paper and on the iPad, framing the investigation through the concept of multimodal participation frameworks. Through multimodal analysis of 25 episodes of video observation, I focus on the multimodal actions that comprised the children's collaborative creativity and identify three patterns of interaction: 1) working together, 2) collaboration 'coming loose' and 3) vying for control. I then explore how the affordances of the resources used were implicated in these distinct patterns of interaction. The analysis suggests that participation frameworks were tighter and more focused on the task when children drew via the iPad, perhaps because the resources were more physically confined, the screen was harder to see and the drawing app produced a novel and dynamic visual effect. During collaborative drawing on paper, the pens often acted as a distractor, drawing attention away from the drawing and disrupting the fluency of turn-taking. These findings suggest the need to challenge the popular perception that iPads facilitate solitary game-playing and video-watching at the expense of collaborative creativity.

Introduction

Touchscreen tablets, such as the iPad, are an increasingly prevalent feature in young children's lives. There are popular concerns that these devices prompt children to engage in solitary activities and to avoid immediate social connections with those around them (Steiner-Adair & Barker, 2013; Turkle, 2017; Wooldridge & Shapka, 2012). The media have also suggested that tablets lead to passive preoccupation with children engaged in game-playing and video-watching and minimal creative engagement (Palmer, 2015; Gray, 2011). Although observational research suggests an alternative view to these claims (Edwards, 2014, 2016; Zaman

et al., 2016), these negative perceptions have contributed to documented resistance among staff in nurseries and schools, who worry that introducing digital devices will inhibit collaboration and creativity among children (Edwards et al., 2017; Palaiologou, 2016). There is a need therefore to observe more closely how the affordances of tablets such as the iPad are taken up in tasks of collaborative creativity and how this compares with paper-based resources.

In the following sections I present literature and theory to frame the research focus: perspectives on collaborative creativity; research into collaborative creativity and digital technologies and a theoretical frame based on concepts from social semiotics (semiotic resources, affordances) and the multimodal analysis of communication (participation frameworks). Following a breakdown of the study design and methods of data analysis, I describe three patterns of multimodal interaction that were observed: 1) working together, 2) collaboration 'coming loose' and 3) vying for control. For each of these patterns of interaction, I consider how the affordances of the resources were implicated in these patterns of interaction. In the discussion, I explore the implications and limitations of the findings, which show that the iPad is more supportive of collaborative creativity than is perceived to be the case in popular media and centres of early childhood education.

Collaborative creativity

There is a growing interest in creativity as a social, rather than individual, phenomenon. Glaveanu (2010, 2017) has charted the rise of what he describes as the 'We-paradigm' in creativity. This is a way of thinking about creativity that emphasises the social and material environment in which creativity occurs as opposed to focusing on creativity as an individual capacity. This way of thinking about creativity builds on a long and rich history of research into how creativity emerges and develops among in group situations (e.g. Fiedler, 1962; Abric, 19671; Siau, 1995; Paulus & Nijstad, 2003). Research by Sawyer (2004, 2011) has highlighted the importance of group improvisation in creative processes, and observation studies of children engaged in creative tasks together, demonstrate how creativity can be seen as something that exists between – rather than inside – individuals (Hamalainen & Vahasantanen, 2011; Burnard & Younker, 2008).

At its most basic, collaborative creativity can be thought of as the emergence of a shared idea between two or more individuals. Therapeutic perspectives suggest that the development of these shared points of reference can be powerful in bringing people closer together. For example, Hosea (2006) observed the way that mothers and young children grow physically and emotionally closer to one another through the process of making art together. Shared art-making enabled them to pay more attention to one another and to have new ways of communicating with each other, for example, using colour as a way to express feelings to each other and build mutual positive affect. This is the fundamental idea in the game of 'Squiggle' created by Winnicott, which is used in this paper as a way to structure children's collaborative drawing experiences. In Squiggle, one participant begins a drawing by making a 'squiggle'; the other participant integrates the squiggle into a representation. Winnicott (see Berger, 1980) explained that this activity would bring participants closer together and could therefore be used to offer a strong foundation for communication between a therapist and child. The game applies Winnicott's (1971) notion of 'potential space', which constitutes the overlap between an individual's personal representational space and the shared representational space.

Despite the basic explanation of collaborative creativity as a 'shared idea', it is important to think about collaborative creativity as more than just a cognitive process. Vass (2007) and Rojas-Drummond et al. (2008) argue for the importance of taking into consideration the physical and affective dimensions of collaborative creativity and Grossen (2008) emphasises that each moment of collaborative engagement between peers 'is a concentrate of various and heterogeneous spaces, identities and uses of objects or symbolic tools' (p. 247). When we observe children collaborating, we need to look not just at their shared ideas (as articulated through speech), but also their togetherness in the task as manifest through their bodies. To witness and understand collaborative creativity through observations, we therefore need to engage with a wide range of modes of interaction, including gaze, facial expression, body orientation, movement, gesture and touch – what Goodwin (2000) describes as the entire multimodal ensemble of communication.

Collaborative creativity and digital technologies (particularly the iPad)

How resources facilitate collaborative creativity will depend on their physical properties and their social associations. According to Rogers and Lindley (2004), digital interactive displays are characterised by 'accessibility, visibility and "shareability" (p. 1134), though their observations related to large horizontal displays that could process simultaneous input from multiple users. With the iPad, even though it is also a digital device, the small size of the display and the fact that only one person can use the touchscreen at a time mean that these characteristics are less applicable. Wohlwend (2017) observed collaboration between children as they engaged with the PuppetPals digital puppetry app on the iPad and described children 'vying for physical space on the glossy surface of a 9.5 inch screen' (p. 57). Rather than understanding this as having a negative impact on collaboration, Wohlwend describes this as a physical manifestation of the work involved in negotiating 'disparate visions for the unfolding story' (p. 57). This suggests that resources perhaps do not need to facilitate 'tidy' co-co-working in order to support collaboration; vying for space and access to the resources might contribute to particular practices of collaboration rather than negating it all together.

In addition to considering the physical properties of the iPad and how these are likely to shape collaborative creativity, we must also take into account the social associations of the device. While iPads and other digital devices are hardly new, they can be seen as a relatively novel resource in the context of mainstream educational institutions. My own research (Author, 2017) suggests that digital technologies used in the classroom will be subject to particular expectations. To use the term of Burnett (2014), the way that digital technologies are taken up will be influenced by the 'classroom-ness' of the context. Practically, this might manifest as an emphasis on turn-taking that would not exist in an informal learning context. As Russell et al. (2002) notes, users are often unsure about how to engage with digital interactive displays in public spaces since 'the etiquette of multiple person use is unclear' (p. 232). Similarly, the collaborative practices that surround iPads are likely to be less 'fully and finely articulated' (Jewitt & Kress, 2003, p. 2) than those associated with resources such as paper and pens, which are used on a daily basis in educational institutions.

Semiotic resources and affordances

Social semiotic accounts of meaning-making suggest that how meaning is made depends on the specificity of the sociomaterial context (Hodge & Kress, 1988; van Leeuwen, 2005). 'I love you' written on a post-it note in felt-tip marker has a different meaning to 'I love you' written at the bottom of a piece of A4 lined paper with pencil. In these scenarios, the semiotic resources I use are different. Semiotic resources are the 'actions and artefacts' (van Leeuwen, 2005, p. 2) through which we make meaning. It is important to note that the term 'semiotic resources' extends beyond just the actual materials that are used to also include the actions through which we engage with the materials. In this study, the iPad is seen as constituting a different set of semiotic resources to the application of felt-tip pens on paper. It is not just the material tools in either situation that comprise the semiotic resources, but also the actions (e.g. particular types of touch or manipulation) that are used to engage with the iPad or paper or pens.

How meaning is shaped by semiotic resources depends on the affordances of the semiotic resources. The concept of affordances stems from Gibson's theory (1961) of direct perception in ecological psychology, in which he argues that our perception of objects centres on the actions that the objects invite, rather than the development of an abstract understanding of the objects. This theory suggests that rather than seeing a chair as a chair, what we perceive is the affordance of sitting. Social semiotic accounts of meaning-making take this idea and apply it to different semiotic resources, including different modes and media (Jewitt & Kress, 2003; Bezemer & Kress, 2015). When the term 'affordances' is used in this context, it applies to both the physical properties of semiotic resources and how these afford engagement, as well as the social associations – or 'cultural investment' (Kress & Jewitt, 2003, p. 2) - of the resources. To return to the example of post-it notes, the affordances of writing on post-it notes depend on both the physical properties of the post-it note (e.g. size, colour) but also the social associations of post-it notes (e.g. informality, fast-paced, disposability).

In studies of children's art-making, different semiotic resources have been shown to afford different forms of engagement and have distinct 'gains and losses' (Kress,

1997; Kress, 2005). My own studies of digital art-making have suggested different meaning-making pathways when digital semiotic resources are used (Author, 2016, 2017). For example, in one study of four and five year olds' drawing on the laptop computer, I found fewer oral narratives to accompany drawing than when children were drawing on paper. I suggested that this was because of the faster pace adopted by the children in art-making on the computer, which was in turn shaped by the physical properties and social associations of the computer.

Multimodality and participation frameworks

While there is a tendency in social research to prioritise speech in order to understand interactions, individuals coordinate their communication and activity through a range of modes in addition to speech. Other important modes include gaze, body orientation, posture, movement, manipulation, facial expression, gesture and touch (Kress, 2010; Bezemer & Kress, 2015; Author et al., 2016). These modes do not exist in isolation – they are part of the 'multimodal ensemble' of communication (Goodwin, 2000). Having said this, modes can be analysed separately from each other and can be thought of as having their own affordances (Jewitt & Kress, 2003).

When researching collaborative creativity, we can look at how different modes of interaction are organised in order to create particular participation frameworks. A participation framework is the organisation of activity through bodies in space to enable a particular form of interaction and engagement. In Goodwin's (2007) study of a father and a daughter engaged in a homework task together, he uses the notion of the participation framework to look at how the interaction unfolds. In this case, the participation framework is made up of three points: the daughter, the father and the paper task they are engaged in. Different modes of interaction generate and sustain this participation framework, but can also disrupt it. Goodwin shows how the orientation of gaze for example plays a fundamental role in at times enabling closeness between the father and the daughter and effective collaboration, but at other times it acts to de-couple the intentions of the father and the daughter and denotes tension in the interaction. The notion of the participation framework builds on Goffman's (1972) earlier work in which he introduces the term 'ecological huddle' to describe how attention shared between participants is directed at a particular artefact of interest.

In a collaborative drawing task conducted at a table with the participants sitting down, we might expect the participation framework to look a certain way. We might expect the gaze of the participants to rest on the shared drawing or perhaps to be on each other. We might expect bodies to be leaning in towards the drawing. We might expect both sets of hands to be reaching out in order to gesture at or touch the paper/screen, or we might expect to see turn-taking in the use of gesture, touch and manipulation. How the participation framework manifests will be shaped by the affordances of the semiotic resources that are used in the collaborative drawing task. What differences might we see in the participation frameworks involved in collaborative drawing on the iPad versus collaborative drawing on paper?

Study design

The study initially involved twelve children aged 5-6 years organised into six pairs. The children were recruited through a comprehensive primary school local to the researcher's university. In this context, the children had an opportunity every so often to use iPads in the classroom but this was typically through taking turns on the iPad rather than using them together. The study was explained to the children verbally and in writing to their parents/carers, who gave written informed consent for their participation, including the use of video observation in order to collect data and support the dissemination of the findings. The study design was approved by the university ethics committee. The pairs of children were assigned by the classroom teacher based on who the teacher thought would work well together and this may have impacted on the levels of collaboration that were observed. Each pair was taken out of their classroom to a quiet reading area just outside the classroom. The game 'Squiggle' was explained to them briefly: 'one of you will start the drawing with a squiggle and the other will turn the squiggle into something else', and there was a practice turn between one of the children and the researcher to ensure there was a basic understanding of the game. For three of the pairs, Squiggle was played first on the iPad three times and then on paper three times. When drawing on the iPad, the children used the app 'Kids Doodle' which is a free drawing app for children that enables them to choose different colours and effects (such as neon, fireworks, rainbow brush, oils etc.) to create line drawings, as well as spontaneously shifting colour and brush size as the drawing unfolds. For the other three pairs, this order

was reversed. During the games, I interacted with the participants in different ways: commenting on what they had drawn, asking them questions about the drawing or the experience and sometimes reminding them of the rules of the game (e.g. reminding the first participant just to start with a squiggle, rather than creating a more specific representation).

Data was captured through a videocamera on a tripod, though at points I picked up the camera in order to capture particular details that I wanted to remember. Unfortunately, some of the video observations were lost due to malfunctions with the camera equipment. As a result, I ended up with a total of 25 episodes on video, each capturing an individual game of Squiggle. 15 of these episodes were on the iPad and 10 were on paper. The episodes featured ten of the participants (five pairs) since the camera had malfunctioned for one of the pairs originally observed. The episodes captured range from 39 seconds to 190 seconds in length.

Data analysis

In order to investigate the participation frameworks that manifested across episodes, I first made rough multimodal transcriptions of all the episodes. These rough transcripts involved a written account of each episode separated into verbal activity and nonverbal activity. Through this initial transcription stage, I familiarised myself with the data and made note of any impressions I had had while collecting the data. The separation into accounts of verbal and nonverbal activity ensured that my focus, in line with a multimodal approach, was on more than just the speech in order to understand the interaction (Bezemer & Mavers, 2011). I annotated the rough transcripts in response to my research question. Through the processes of rough transcription and annotation, I became aware of different patterns of interaction – broadly, that sometimes the collaboration appeared to be smooth, while at other points it appeared to fade or become fractious. To gain further insights into this, I returned to the video data and compiled a table of 58 'interesting moments' – these either represented a peak of intensity in a particular pattern of interaction (e.g. a moment where children appeared to be particularly in the flow of 'working together) or a shift from one pattern of interaction to another. Through analysis of these moments, three distinct patterns of interaction emerged, which I have labelled 1)

working together (apparent in 35 moments), 2) collaboration 'coming loose' (apparent in 8 moments) and 3) vying for control (apparent in 15 moments). Patterns of interaction were fluid and non-linear in how they appeared, by which I mean that each pair could be seen to engage with different patterns of interaction at different points in the activity, and that interaction could move between these patterns of interaction in any order.

In the next step of the analysis, I aimed to gain insights into how the semiotic resources were feeding into the different patterns of interaction. In this analysis, each moment was represented through a screenshot accompanied by notes on the multimodal interaction as it was unfolding at this point, how the interaction appeared to feed into collaborative creativity and how the affordances of the resources were implicated in this moment of interaction. The latter analysis resembles the approach of mediated discourse analysis which examines sociocultural activity as it unfolds and looks at physical actions as units of analysis (Wohlwend, 2013; Scollon & Scollon, 2004). Below, I first describe the three patterns of interaction I identified, explaining the multimodal participation frameworks that comprised each pattern. Following this, I hone in on the affordances of each set of resources and how they were implicated in the multimodal participation frameworks that I observed.

Working together

Working together was characterised by shared gaze, facial expressions indicating high levels of engagement, simultaneous movements in response to the drawing, physical closeness between the participants, the smooth handover of resources and gestures that returned attention to the drawing and thereby extended the activity.

When participants were working together, the gaze of both participants was typically directed on the drawing. Through this shared gaze, the participation framework resembled the triad of attention described by Goodwin (2006), where participants are brought closer to each other by sharing an external reference point. At other points, participants mirrored each other in their gaze. For example, in episode 14 with the iPad, the participants appeared to both 'look inwards' through gaze in order to find ideas for the drawing (figure 1).

INSERT Figure 1

Facial expressions showed surprise and interest in relation to the drawing. The participant who was not drawing demonstrated intense interest through extreme facial expressions of surprise, disgust or joy (e.g. figure 2). These signalled to the other participant that they were still part of a collaborative task and were being closely observed by others.

INSERT Figure 2

In terms of body position, participants leaned in towards the drawing and sometimes came off their seats so that they could get physically closer to the paper or the screen. This movement would bring the participants closer to each other but indirectly. The participants moving physically closer to each other in a more direct way was surprisingly rare. There was only one moment I observed were the participants leaned in towards each other to confer about the drawing.

Participants indicated togetherness through simultaneous movements in response to the visual activity of the drawing – this was observed in three episodes of drawing on the iPad. In these moments, the participants would move backwards, indicating surprise – they were literally 'taken aback' at the same time point. Such simultaneous movement highlighted the extent to which the participants were experiencing the activity together and heightened the closeness of the collaboration.

Participants' hand actions while working together varied between and within episodes. I observed many moments of what appeared to be vicarious touch, where the participant who was not drawing would rub their hands on the tabletop and use their fingertips to 'draw' on the table and sometimes in the air (figure 3).

INSERT Figure 3

At many other times, the participant who was watching rather than drawing kept their hands firmly clasped as though they were actively inhibiting the desire to reach out and touch the resources.

Working together was characterised by a smooth transition of the drawing equipment from one participant to another. For example, the participant who had been drawing would clearly signal that they were ready to move the equipment over through a 'hands up and off' gesture. The other participant could then reach over and take the resources without worrying that they were interfering or interrupting.

Other hand actions appeared to actively sustain and extend the collaboration. For example, in episode 6, the first drawer pointed out something to the second drawer through deictic gesture, this brought shared attention back to the drawing, and the second participant returned to the drawing and began to add more. Participants could also extend the collaboration through more passing of the resources than was necessary according to the rules of the game. For example, in episodes 6, 13 and 15, the second drawer attempted to pass the drawing back to the first drawer rather than declaring the drawing 'finished' suggesting that they had an instinctive response of wanting to continue the collaboration through additional turn-taking.

Collaboration 'comes loose'

Collaboration coming loose was characterised by divergent gaze, the use of 'fidget objects', less explicit signalling around turn-taking, the adoption of different physical levels and more pronounced involvement from me in the completion of the task.

While it was typical for both participants to direct their gaze on the drawing for most of the activity, when the collaboration was coming loose, the focus of the attention would be broken and one or both of the participants would rest their gaze elsewhere (figure 4).

INSERT Figure 4

As in figure 8, attention could 'leak' from the collaboration (when paper was used) through the manipulation of the pens. As the momentum of collaboration slowed down, the pens were increasingly used as 'fidget objects'. When the participant who was not drawing indicated intense interest – through gaze and manipulation – in the pens rather than the drawing, this is likely to have impacted on the other participant's sense of accountability to the collaborative nature of the task, so that they felt less inclined to invite the other person to have a turn with the resources.

Another way in which the participation framework appeared to come loose was through divergence in the physical level of the participants. As noted earlier, working together was characterised by the physical closeness of the participants – similar to the 'ecological huddle' described in Goffman's observations. On the other hand, as the sense of collaboration faded, the participants became more distant from each other. Sometimes they moved apart laterally but at other points they occupied

markedly different vertical levels. In figure 5 for example, we see one participant standing up while the other participant draws sitting down. This denotes a clear lack of interest from the participants standing up in the drawing as it develops.

INSERT Figure 5

In the moments where the collaboration appeared to be coming loose, my involvement in the activity often intensified. My use of gesture and touch became more pronounced when I felt that the participants were 'losing their way' in the collaboration. For example, in episode 24 (figure 6), I make a gesture as I explain that the participant can have 'just one' pen for his drawing. In this moment I remember feeling concerned that one of the participants (on the left) was eager to take control of the situation and to dominate the drawing activity. One way in which he appeared to be attempting to do this was by describing all of the colours he was planning to include in his drawing. This indicated that he planned to spend a long time on his part of the drawing and also that he wanted to do more than just a squiggle, thereby breaking the rules of the game as I had explained them. My gesture – as well as relating to the 'just one' of the pens – was perhaps an attempt to bring his attention back to the parameters of the collaborative drawing experience and the need to facilitate the creative actions of the other participant and not just his own. Similarly, in episode 8, the video shows me reaching forward to move the sheet of paper from one participant to another in order to keep up the momentum of the collaboration and keep interest and attention on the drawing.

INSERT Figure 6

Vying for control

Vying for control was characterised by the use of gesture and touch to interfere with the other person's drawing activity, the drawer physically blocking this interference, and the taking of resources from each other without these being passed across (i.e. 'snatching').

Gesture and touch were sometimes used by the non-drawing participant to enter into the space of the drawing and interfere with what the participant who was drawing felt

to be 'their go'. When this happened, they were sometimes quickly rebuffed and they retreated from this space. In other episodes, there was a contracted struggle for space conducted through gesture and touch. In episode 9 for example, we see the hands become increasingly intertwined as the participants vie for control of the paper (figure 7).

INSERT Figure 7

Some participants had to block the interference of the other participant multiple times. In episode 17 for example, the same participant repeatedly reached out to try and take the iPad away from the other participant while he drew. The participant engaged in drawing kept his hands on the device in order to block this interference, and at another time he responded by moving the iPad just slightly to the other side of his body so that it no longer sat between them. In these moments, the task was visibly non-collaborative since the drawing was no longer between the individuals.

A bigger challenge to the participation framework was posed when participants took pens from each other. In episode 24, both participants reached out at different points to grab pens that had not yet been offered to them. This broke the etiquette of turn-taking and exacerbated the sense of separateness that pervaded the multimodal interaction in this episode (already discussed in relation to the differences in body position) and created an atmosphere of conflict in which control over the situation was enacted through possession of the pen. This echoes observations of episode 7 where the pen was used to repeatedly interfere with the drawing of the other participant by playing subtly with the paper.

How the resources shaped patterns of interaction

Dynamism of the iPad drawing feeds into a tighter participation framework

Shared gaze on the drawing – a key characteristic of working together – was more typical of drawing on the iPad than on the paper. This was coupled with bodies assuming more physical closeness, also suggesting the maintenance of a tight participation framework. In addition, the iPad drawings were associated with a large amount of vicarious touch when participants were working well together. These features of collaboration on the iPad may have stemmed from the dynamism and novelty of the visual effect that drawing on the iPad, through the app Kids Doodle,

creates. As discussed by Flewitt et al. (2014), we need to think differently about touch in digital environments – although some may see the sense of touch as impoverished through interactions with cold, hard screens, dynamic digital displays may actually lead to a greater role for vicarious touch, whereby users who are not physically engaging with the activity (in this case the non-drawing participant) still 'feel' the experience intensely through the visual activity that unfolds through the screen. In this study, the frequent facial expressions of surprise may also have been related to the excitement of the changing display on the iPad and the visual effect created by this particular app, which spontaneously changed colour and brush size as the children drew. In other research, I have suggested that the fast-paced accrual of visual activity on digital screens may move faster than children's processing and articulation of ideas for drawings; as a result, this may create a greater sense of dynamism and surprise, since the resources – rather than the children – are moving the activity along (Author, 2016, 2017, 2018). This is also related to those moments when the children are simultaneously taken aback, showing their shared surprise through moving backwards in their chairs at the same moment. These moments can be interpreted as 'moments of meeting' (Stern, 2000, 2004), that is, moments of particular closeness in which individuals affectively align with each other. In the moments of shared surprise, the affective alignment of the individuals was visible through the mirrored body positions, movements and facial expressions.

Pens divert attention and interrupt flow

How did the affordances of drawing on paper relate to the finding that gaze was typically less directed at the drawing in these episodes? The key factor here seemed to be the pens, which appeared to sometimes divert attention away from the drawing itself. In some episodes, the participant who was not drawing still held a pen and fiddled with this while they waited for a go. This was unlike the vicarious touch directed at the tabletop since the latter occurred while gaze remained on the drawing; touching the pens was accompanied by gaze on the pens, indicating a lack of interest in how the drawing was unfolding. Even when participants were not holding a pen, the pens appeared to draw their attention away from the drawing. In figure 8, we see one participant look longingly towards the pens on the table and the sense of longing is heightened through his body position with his head resting on the table;

this intense gaze is at the expense of a sense of interest and enjoyment associated with the collaborative drawing activity. This may have led the other participant to feel more alone in the task and less accountable to the collaborative nature of the activity.

INSERT Figure 8

Since pens are a common resource used in schools, we might wonder why participants appeared to give them so much attention. Some of the conversations of the participants during the task, and some of their comments following the activity, suggest that the pens were important to them because of their relationship to colour. One of the participants explained after the activity that if they were to play the game again, they'd play on paper 'because of the colours'. Drawing on the iPad also involved the use of colour but there was a stronger sense of control over the use of colour when drawing on paper. In the iPad app, the colour changed spontaneously in addition to being changed manually. On the paper on the other hand, just one colour could be used at a time and a conscious decision (accompanied by a sequence of physical actions) was necessary if a new colour was to be used. Previous research suggests that experimenting with colour may be a particularly important part of the drawing process for some children (Coates & Coates, 2006). The pens were not just a physical distraction from the collaborative task, diverting gaze away from the drawing, but also a symbolic diversion since some children responded to the sight of the felt-tip pens with a desire to experiment individually with the colours and engage with their personal affective response to these colours.

The iPad screen is less easily visible and this prompts participants to move closer

Although participants leaned in during both drawing on the paper and on the iPad, this form of movement appeared to be more extreme when drawing was on the iPad. In these episodes, the participants tended to come off their chairs and crane around the body of the other participant in order to get a better look at the iPad screen. Their body position was typically in flux, moving back and forth and around in order to shift their line of sight. These actions may have arisen as a response to the poor visibility of the iPad screen, particularly in the glare of the overhead lighting. Although this can be seen as a problem in the design of the resources – a physical property that inhibits effective collaboration and promotes solitary engagement - these findings

suggest that the multimodal response of children to this property can sometimes lead to heightened closeness in the collaboration. As children engaged in more extreme bodily movements in order to see the screen, they signalled to the other participant that they were keenly interested in the development of the drawing. This finding echoes Wohlwend's (2017) research, in which the small screen of the iPad was associated with intense physical dialogue between participants as they both attempted to impact on the small space. Even though the small screen could be seen as a barrier in collaboration, how multimodal interaction played out around this physical property was supportive of collaboration. More generally, these examples highlight the need to distinguish between theoretical and actual semiotic potential (van Leeuwen, 2005) that is, our theoretical assessment of the affordances of resources, versus the way that the resources are taken up in everyday interactions.

The iPad is easier to pass between participants

The way the drawing was passed between the participants depended on the physical properties of the drawing resources. With the iPad, it was only the device that needed to be handed over, whereas both the paper and the pen needed to be passed across when the drawing was on paper, and this required additional actions such as putting the lid back onto the pen. With the paper there were more composite manoeuvres in the transition and this jeopardised the smoothness of the transition, since turn-taking could not flow as instinctively as when just one object needed to be moved across. This observation relates to the feature of accessibility described by Rogers and Lindley (2004) in relation to large vertical digital displays, and also to the research of Mercer et al. (2010) which suggests that children's collaborative dialogue can flow readily around the IWB as a result of the simplicity of physically engaging with the IWB. On the other hand, when drawing was on the iPad, the second participant was more likely to reach across and attempt to take the drawing without being invited to do so. This may have been because there was only one device to try and gain control over or it may have been a consequence of fewer formalised conventions of turn-taking surrounding the iPad due to its relative novelty and lack of 'cultural investment' (Jewitt & Kress, 2003, p. 2).

Discussion

The findings in this study highlight different patterns of multimodal interaction that arise during collaborative drawing on the paper and on the iPad. The findings describe how different patterns of collaborative engagement unfold through distinct multimodal participation frameworks and how the affordances of particular resources used in the drawing task feed into these patterns of interaction. I have suggested that the novelty and dynamism of the visual activity on the iPad may have maintained attention on the task, and that the poor visibility of the screen may have led to more physical demonstrations of interest in the drawing which in turn bolstered the sense of collaboration. On the other hand, the pens appeared to divert attention from drawing on paper and made passing the resources a lengthier, less apparently instinctive process, so that the collaboration was more liable to coming unstuck with a loss of momentum in turn-taking.

The findings presented here do not support the popular concern that iPads are not conducive to collaborative creativity. Instead, the findings suggest that the affordances of the iPad and this particular app, KidsDoodle, will foster collaborative creativity through the facilitation of a tighter multimodal participation framework. For early years educators and parents, this might suggest that we need to worry less about children's exposure to digital environments, particularly if we are prepared to encourage activities of collaborative creativity on tablets. Encouraging collaborative creativity involving tablets might take the form of setting tasks where children work together to make visual art, music and videos together on the tablet, or engage in shared storytelling through apps that enable the creation of personalised multimodal stories. In times for free-flow play, we could support collaborative creativity via digital technologies by making the technologies available and refraining from the need to limit how children use the resources through rules around turn-taking. Instead, we can see the collaborative activities that emerge when children are left to their own devices. If we expect tablets only to be used for solitary game-playing or video-watching and never enable or allow situations of collaborative creative engagement (as encouraged here), then we will end up with a situation in which tablets have a strong social association with these kinds of limited use. The more time we spend proactively engaging with children as they use digital devices, the more we can model and support positive forms of engagement (Plowman & Stephen, 2005; Byron,

2008). To support educators and parents in their encouragement of collaborative creativity using the iPad, more information needs to be available about the different apps that can be used, the particular features they offer and how these features are likely to shape children's collaboration and creativity.

I am not arguing that the differences noted in this study between paper and the iPad fall along a digital/non-digital divide. As others have argued, we need to pay attention to the specific affordances of the resources being used (Author, 2015; Burnett et al., 2014; Marsh, 2010). The oneness of the iPad is a feature of this specific resource and the dynamism and novelty of the visual activity which seemed to draw participants' attention to the drawing is a feature of the specific drawing app used in this study. By being clear about the specificity of these properties and carefully documenting the semiotic potential of specific resources, we can open up the potential associated with different resources. For example, we could think about alternative drawing apps that might prompt more 'slowliness' in art-making (Denmead & Hickman, 2012). To explore further how collaborative drawing unfolds through interplay with different material resources, it would be helpful to observe children's collaborative drawing with a wider range of resources, including apps that display a more 'basic' visual effect and paper-based resources that are more exciting and novel in a school context (e.g. painting).

Different methodological approaches and a range of research methods would be helpful in supporting this future investigation. Naturalistic observations of collaborative creativity in a free-flow play-based environment would show how children experiment with the affordances of different resources and come up with ways of working that may not have occurred to the designers of the resources. Naturalistic observations would also enable more consideration of how children's collaborative creativity might move across different spaces and resources and the nature of the 'transduction' (Kress, 1997) of ideas across different resources with 'gains and losses' (Kress, 2005) at each point of transition. On the other hand, observations conducted more formally within an experimental framework may help us to focus on how particular design features appear to shape specific modal dimensions of collaborative creativity, such as participants' body position in relation to each other.

I have reported here a small observation study. The differences noted might not apply in other situations, and other differences might be noted when paper and iPad collaborative drawing is observed by others. This paper does not offer a definitive comparison of the resources, or a definitive account of the semiotic potential of either set of resources. Instead, it puts forward particular suggestions regarding the semiotic potential of different resources used in collaborative drawing. It challenges a dominant discourse that surrounds the use of digital technologies in childhood, by showing how the affordances of digital tablets and drawing apps can be more supportive of collaborative creativity than more traditional resources used in drawing tasks. It invites further exploration of digital and non-digital resources in order to understand more how specific affordances shape the participation frameworks that emerge in collaborative creative tasks among children.

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