LEONA HOLLOWAY: Thank you very much and thank you for the opportunity to speak today. As you said, I want to talk about a two-year project we did looking at access to graphics for students who are vision-impaired in higher education. I will start just with some background. Sorry, I've moved to slide 2. I will start with some background on the project itself and talk a bit about our methodology, our findings and our recommendations. Hopefully many of you already know a bit about the project. We did have a call for participation and a lot of people helped out through the austed-list with the studies and I also presented at last year's Pathways conference. Secondly, I will look more closely at some of the recommendations from the project with the goal of helping you to make decisions about which graphics need to be converted into another format, what techniques to use to do that conversion or for the student to access the materials themselves and also where to find the information that you need to implement the solutions.

So slide 3, just an introduction first. The project was led by Monash and Deakin Universities. From the Monash faculty of IT we had Kim Marriot, Matt Butler and Cagatay Goncu, who came with a lot of expertise in research and technology. I came from a background in accessible formats production. We also had Merrin McCracken and Tom Perry from Disability Services at Monash Uni and at Deakin to bring their perspective to the team. We were also fortunate to have an active expert reference group with representation from the University of Adelaide in the Disability Services. From Vision Australia, mainly from their accessible production team, also from the state-wide vision resource centre for primary and secondary school students in Victoria, who have a vision impairment, so again in the production side and support, and the DIAGRAM Center in the U.S. where they're doing a lot of work on new technologies for accessing graphics. And we also had a blind consumer representative with a background in policy and mathematics. Not to forget Matt Brett from La Trobe University who served as an external evaluator. So we were aiming very much to have a very collaborative project with views from all of the stakeholder groups.

Slide 4. It was a two-year project that was funded by the office for learning and teaching. The first stage of the project was to gather information about what access vision-impaired students currently get to graphics in higher education and also the broader context that influences the level of access. We conducted a national survey of students with a print disability and we got 71 respondents from all over Australia. I think there were 26 different universities. There were 34% who were blind and the remainder were low vision or just a couple with a print disability. It's also interesting to note that we had half of the respondents had a deterioration in vision in the last five years. So there's a high proportion of our students who are dealing with a new disability and don't necessarily have all of the tools and skills that they require. We also conducted semi structured interviews in person or by phone with 42 different people. We had students, academics, a couple of tutors, disability services staff and also accessible format providers. Most interviews were about 45 minutes so we were able to gather quite a depth of information.

Slide 5. Overall what we found was that the access to graphics can be a neglected area for vision-impaired students in higher education. 84% of the surveyed students said that they skip graphic materials that could potentially be valuable, either sometimes or often, and 94% of the students in the survey said they could benefit from improved access to graphics. This had a definite impact on the students. So half said that they had avoided a potential area of study or a career due to concerns about access to graphics and in the interviews many who said that they hadn't avoided a study area actually went on to tell stories about how they had dropped a subject or avoided a subject because of problems. We could also observe the effect of accessibility on the subject area directly. So of the students in the survey, there was a very high proportion who were studying Society and Culture because it was a text-based area of study and a much lower participation in STEM subjects and this was a statistically significant difference. What we found basically was that students are not getting equitable or adequate access to graphics and that this is affecting them both at university and in their careers after university.

Slide 6. The next stage of the project was pilot studies. We conducted a series of studies, each for one semester, and we worked with eight students, either for one or two semesters each, and also with everyone else involved in providing access to the study materials, so their disability advisers, lecturers, tutors and accessible formats providers. We worked closely with all members of the team to determine what the students' needs were, to facilitate communication and to trial additional methods for accessing graphics. We also conducted a formal evaluation at the end of semester to see how things had gone. The project team stepped in to provide lots of extra assistance and to trial materials in the first pilot but by the time of the third pilot we stepped back to make sure that the strategies we were recommending could be implemented without our help. After the completion of the pilots, we invited all of the participants from the whole study, so from the survey, interviews and the pilot studies, to a full-day workshop in Melbourne where we shared our findings and we developed as a group a set of recommendations for improvement, which were based on the experience of all of the stakeholder groups.

Slide 7. The outcome of the collaborative workshop was a set of four model principles. These were designed to improve vision-impaired students' access to graphics in higher education, but as you will see, they're also applicable a lot more widely.

Slide 8. The first of the four principles states that the support for the learning requirements of vision-impaired students requires communication and shared responsibilities between students, academics, support staff and specialist services. This means that roles and responsibilities must be understood and agreed to by all stakeholders from the beginning of semester. We also need to foster effective and timely formal and informal communication processes between all stakeholders, and formal mechanisms are required to capture and distribute feedback about disability services and access to materials in the same way that feedback is gathered about general students' experience in university. This principle is, obviously, applicable to support services for all students, not just those who are vision-impaired.

Slide 9. The second principle states that many of the learning requirements of vision-impaired students can be addressed through inclusive teaching strategies. There needs to be an improvement in disability awareness among academics which is something that we found when speaking directly to academics. They don't necessarily need to know about every disability all of the time, but when there is a student who is enrolled, that's when their peak interest is there and then would like to have access to ready, easy information about how they can assist that student.

We also need to encourage use of teaching strategies that improve accessibility and learning outcomes for all students.

Academics are often reluctant to put in place measures for a single student, particularly with vision impairment. They say it's the only blind student they've ever come across, so I don't need to learn this. But, if you can point out how the strategies will also assist other students, then they're a lot more willing to help. And again, this principle is applicable beyond just students with vision impairment.

Slide 10. Moving on to the third principle. Vision-impaired students have specific learning requirements for which higher education institutions are obligated to provide appropriate services and support. In particular, students with disabilities require specialised support for transition to higher education. Students are receiving a very high level of support at primary and secondary school and they're also using equipment that belongs to the Education Department and gets returned to the Education Department. We also have a lot of students from overseas who are coming with a very different level of knowledge about what is available and how to use it, and we again have a lot of students who have a recent vision loss. So all of those students require new skills and new equipment sometimes in order to access the materials at university.

Slide 11 is our fourth and final principle which has most focus on vision-impaired students and graphics. It states that vision impaired students require further specialised support including the use of appropriate strategies for accessible graphics. This means that consideration must be given to the multiple roles that graphics play in the overall learning experience. And I will go into that further in a while. It also means that there's not one correct solution, but, rather, there are appropriate technologies and practices which must be applied to make graphics accessible as best suited to the individual student, the content and the context. Finally, we need to use national networks and partnerships to share expertise, best practice and resources and to keep up-to-date with changes in technology and the teaching environment. Again, we can't keep all of that expertise ourselves all of the time for just in case, but there are a lot of resources that are available for when the time does come.

Slide 12: Applying the principles. That was a very brief overview of the principles, but a lot more detail is given in the full document, which is available on our website at accessiblegraphics.org. In the full document we have a bit more explanation of what we mean. There's also justification and evidence behind the principles and suggestions on how they can be applied and what strategies you can use and what resources. If you're interested in holding a workshop to explore how to apply the principles at your university or TAFE, please do let us know because we would be happy to speak with you. But for now what I’d like to do is to focus on the fourth principle which is choosing and implementing an appropriate strategy for accessible graphics.

Ok, so slide 13. The first question to address is identifying which diagrams need to be made accessible. This is sometimes quite a tricky question.

Slide 14. I'm going super fast, I think. In an ideal world all diagrams will be made accessible in the best possible format. This often is not practical due to time lines and cost considerations and also because students don't necessarily want to be over loaded with access to diagrams that don't provide any extra information or understanding. So how do you choose which diagrams to produce in accessible format? A common approach is to wait for the student to ask, but this has obvious problems. If the student can't access a diagram, then they don't know what it is and they can't make a decision about whether or not they need it. When they're faced with this situation, a lot of students tend to err on the side of caution and just skip over the graphic hoping that it's not important, so that it was something like 84% of students doing that. If the student is not able to identify the right diagrams, what about the lecturer? The problem with this approach is that lecturers often are very busy and they don't have an adequate understanding of what a student can and cannot access. So we have a quote "I wouldn't want to go through and identify which graphics I think are needed ahead of time because I could spend a lot of time worrying about something that the student is perfectly able to access already". The danger is that no diagrams will be produced because it was too hard to choose which ones to do and no-one has spoken up and said which one is needed.

Slide 15. We don't have a simple answer to this problem, but we do have some suggestions about how to tackle it. Firstly, it's important to recognise the importance of all diagrams. For example, one of our pilot students, we provided a description of every single diagram in one of the units, even the diagrams that everyone thought was irrelevant. So even if it was just a pretty picture of a flower, we still gave a description. There's a relevant picture of a flower on there. We were surprised when the student came back and reported that the diagrams they most liked were those of the cartoons on the lecture slides because the cartoons provided a very quick memorable illustration of the topic. It's what they remembered and how they knew what the focus was. It also helped with inclusion, the student knew what everyone else was laughing at and was able to join in. So a basic level of information about most diagrams is actually useful. Secondly, the student needs a minimum level of information about all diagrams so that they can make a decision about which diagrams they want to request further access to. So we don't need full access to all diagrams, but we do need minimal access to almost all diagrams. As I go through the formats, we will talk about a few different ways that students can get that minimal amount of information. In terms of identifying which diagrams need to be made fully accessible from the start, a good place to start is to ask the lecturer what type of diagram will be needed for assessment, and any similar diagrams in the learning materials should also be made accessible in the way that they will be made available in the exam, so the student doesn't encounter anything new in terms of content or format once they get to assessment.

Slide 16. Once you have identified which diagrams are most important and which ones you want at least the minimal information about, the next step is to choose a format to do this. A combination of approaches is needed, sometimes for the same diagram, to suit the individual, the diagram and the situation. We will take a look now at the various formats that you can choose from. I will try to highlight the advantages and disadvantages of each. Hopefully, I will alert you to some options that you're not already aware of and I will suggest some ways of overcoming some of the barriers to using some formats. I won't go into details of how to implement these strategies, but I have listed some resources in the slides and there's also resources on the accessible graphics.org website so you can refer to that when the situation arises and pass the information on to those who can use it.

Slide 17. Enlargement is the most common method for accessing graphics for students with low vision in higher education. Enlargement is obviously the easiest way to implement access, but it's also important to be aware of some of the disadvantages. Firstly, the original needs to be good quality with high resolution and high contrast. That was one of our main complaints from pilot students with low vision, that they were trying to access very poor-quality diagrams. Secondly, it can be difficult to get an overview or to keep your place when you're working with magnification on a screen. Many students can experience headaches or fatigue as a result of relying on magnification and this limits the amount of time that they can spend on the task.

Slide 18. For students who are blind, the most common method for accessing graphics at university is verbal descriptions, but unfortunately it's also the least preferred method. We found that lecturers do try to give some description in the lecture, but don't have time to give a full description and it's certainly not often enough for the student to fully understand. They then will go to other students or family and friends to ask for a description, but because they don't have the subject matter expertise, again it's not a satisfactory result. Also relying on verbal descriptions means that students can't work independently if they're studying for an exam at midnight, there's no-one to ask. While enlargement and verbal descriptions may be good starting points, they may need to be supplemented with other methods for accessing the same graphics.

Slide 19. Written descriptions are the next step up from verbal descriptions. They allow for more independent study and allow for more full and considered description to be provided compared with verbal descriptions. They can also be useful alongside other formats to provide an overview and to assist with navigation. What I found in the pilot studies that providing a brief description for all of the diagrams before the start of semester was actually a good way of identifying those diagrams that have a very strong spatial component and needed to be produced as a tactile graphic or other spatial format because they couldn't be described very easily at all, or adequately. The main difficulty with written descriptions is fear, I think. A lot of people are frightened about writing diagram descriptions because it requires expertise in the subject matter and in how to provide a description. To overcome this difficulty, you can ask a tutor with subject matter expertise to provide the descriptions or you can ask the lecturer or tutor to provide one description that then acts as a pro-forma for others to follow and there are also a lot of training resources and examples that are available online.

Moving on to slide 20, image description apps. This is another way of providing basic information about a graphic. So, basically, the student can use their iPad or a smart phone to take a photograph of the graphic and it will tell them what type of diagram it is. For example, it will say a photograph of a man wearing a suit and they know that's just an illustration of the author and they can skip over that or it might say bar graph and they’ll know that it contains important information and if it's not described in the text they will seek further information elsewhere. So image description apps are ideal for students who are doing independent research. You will find that most vision-impaired students actually already use an image description app for other purposes in their daily lives, but they won't have thought of using it for identifying graphics in higher ed and TapTapSee is the most popular of these. There’s also, just a couple of weeks ago the exciting news is that IRIS is a new image description tool which is specifically designed for maths and science content. Unlike TapTapSee and the likes, which will just tell the student whether a diagram is important or not, IRIS will hopefully be able to give them the information that's contained within the graphics, so it can be a one-stop-shop. They're looking for Beta testers now. So anyone who is interested might want to jump on board.

So slide 21 is on sonification. This is another tool that students can use independently. Basically, the student can enter data or an equation into software and it will then convert it into audio tones. I've got an example here for you, which is using MathTrax by NASA. And what is does is the x-axis is conveyed across time and the y-axis is represented by a high or low tone and there is a beep when the graph touches the axes. So this is a parabola that has the turning point at the origin. Let’s see if I can get it to play, otherwise I will have to sing and I don't want to do that. There we go.

[beeps]

So it gives that audio feedback. There's also a description of the graphic, including the range of the axes.

Slide 22. In terms of statistics, as I mentioned, a lot of students are moving towards text-based subjects to avoid graphics, but they then find that they still need to do statistics and it's become a problem for a lot of students. R is traditionally the most accessible statistics package for navigation and for use by students themselves. There is a Braille R package which you can add in to provide descriptions of graphs and to automatically output graphics as tactile graphics. There's also a really good culture of users who provide online support to one another for using R. SAS has burst onto the scene in the last month with the announcement of a free add-in called the SAS Graphics Accelerator. This will give you, like MathTrax as I just showed, it will give a description, sonification and the sonification moves from your left ear to your right ear, which is nice, and it also will give a description of the data. It works not just for graphs that you've created yourself in SAS, but also for any graphs on the internet that have been created that way. If it's at all possible for students to use these packages rather than any other type of software for their statistics, it will mean that they can work more independently and gain better access to their own work.

Slide 23. GraVVITAS, which is an accessible graphics suite developed by Cagatay Goncu here at Monash. It consists of an author tool that’s designed to be very easy to use to create simple graphics and associate an audio tone and a descriptive label to each area of the graphic. There's also a reader app to access the graphic on an iPad or iPhone. As the student touches each area of the diagram, it will read the label and play a tone. I've got an image of a brain that was created in GraVVITAS as you move your finger over the blue area, it will say frontal lobe, and as you move across it will tell you what lobe you've moved to. So while GraVVITAS doesn't give you as much fine detail as a tactile graphic, it is able to convey spatial relationships in a way that you can't get from a description. It's particularly good for diagrams with very long labels or for students who don't read Braille. It's also good in that you can create the graphics very quickly without a high level of expertise. So it can be used within the university and, perhaps, even just by the tutor. The other advantage is that it's a lot less bulky than tactile graphics. So it's easier to carry a hundred diagrams around on your iPad than sheets of paper flying everywhere. It's available for use now, but it's still within development. So please do contact Cagatay if you have a student who might be interested in trying it out.

Moving to slide 24 and back to more traditional methods. Tactile graphics are widely recognised as the ideal format for graphics with spatial information. It is important to note that depending on the subject being studied, they're usually only required for around 5 to 10% of graphics. We found that tactile graphics are underused in higher ed. Out of 20 students in our online survey who were able to use tactile graphics, only six received them in this format at university and a lot more said that they would have liked to have received the tactile graphics. This lack of provision is due in part to a concern about costs and time required for production of tactile graphics. And there's also a concern that students require a higher level of tactile literacy to use tactile graphics effectively. So they need to have the tactile acuity, they need to have an understanding of visual or graphical conventions and it helps to know Braille as well.

Slide 25. In terms of overcoming these barriers, for tactile literacy it's exposure to tactile graphics that students need to maintain and develop their skills. It's important that if a tactile graphic is going to be needed once in the semester, that that once is not the only time, that their exposure to tactile graphics is maintained throughout. It can also assist by accompanying a tactile graphic with a written or verbal description, with the type of diagram and the direction for reading. I have an example on the slide of a handmade tactile graphic and all I would need to say about that is that it is a tree diagram, starting with 1 at the top and then branching down. So that small amount of information would give the student enough that they can navigate the diagram more easily. If they're not a Braille reader, then you would be reading the labels to them as well. A tactile graphic can still be useful to convey spatial relationships even if the student doesn't read Braille or have the higher level of tactile literacy. While they're not suitable for exam situations, hand-made tactile graphics like the one on the slide are an option for quick access to materials in class. So in our pilot I spent around 20 minutes with a tutor and I gave him a couple of cheat sheets and some basic materials worth about $20 and he then went on to produce quite a number of diagrams for his student throughout the semester that he otherwise would have gone without access to.

Slide 26. The last format I wanted to talk about is 3D models. 3D models might be found objects, they could be educational kits, they could be hand-made models or they could be 3D prints that already existed in online repositories or that have been designed fit for purpose. 3D models are essential, but only for a very small proportion of diagrams which are three-dimensional in nature. So things like anatomy, geography, are obvious areas where 3D models are really valuable. Other areas like maps and mathematics we found they can also be useful because they're intuitive and easy for blind students to use, and unlike tactile graphics, they're appealing and useful for all of the students, which encourages inclusivity.

Slide 27. Summing up, diagrams and graphics are an important component of access to learning and environment in higher education. But provision of access to graphics doesn't need to be difficult. While there's not one solution that will fit all circumstances, it's possible to match the strategy to the student and the situation. We don't all need to be experts, but if we can join communities that are out there, when it's relevant, we can learn from each other and share our own tips and tricks. With advances in technology, we think the best practice in graphics accessibility is well within reach and will help students to reach their true potential. I've just included a little quote from a blind student from our pilot studies who needed to deal with a lot of difficult graphics but she ended up getting very high marks with thanks to the efforts and communication between disability services and the academic teams.

Slide 28. If you would like any more information about our work or today's topics, the survey and the interview results and also a discussion of the results were published in the HERDSA journal last year, so I’ve given the reference for that. We have also created a website at accessiblegraphics.org where you can find out more about our work and there's the full Principles document as well as information about choosing a format and information about each of the formats we covered today along with some tip sheets on how to implement. Please do contact us if you'd like more information or you'd like to discuss arranging a local workshop. The next few projects that we're looking at are working more closely with 3D printing for accessibility. So we've done things like creating interactive location maps, and I know that accessibility of the campus has been a discussion recently, so if you're interested in exploring that, please contact us too. But for now, thank you very much for your time and for your attention.

DARLENE MCLENNAN: Great, thank you. That's fantastic. I just encourage people to ask questions in the question pod. We’ve got a couple that have come through Leona. For the first question is “how can we format math charts for students with no vision without giving away the answers?”

LEONA: Maths charts?

DARLENE: Yes. I think that's right. Yes, maths charts.

LEONA: Without giving away the information? I'm not quite sure I know what they mean by "math charts". I know that in giving descriptions of graphs it's sometimes difficult to do that without giving away the answer. So I think some of the other solutions that I talked about, such as the sonification software and tactile graphics, they do need to search for the answer themselves. Hopefully that answers the question, but if not please contact me further.

DARLENE: That's great. Thank you. Also someone has just asked is there any more information about the RS project that's happening? Is there anywhere to get more information?

LEONA: Yes. I included the reference on the slide, which was slide 20, so I will flip back to it. The Grapheel website, so it’s www.grapheel.com, so they have the call for participants on their website.

DARLENE: Fantastic. And just one of the other things that the video that you showed or the actual graph, we didn't actually get to hear that, worst luck, which is a shame.

LEONA: The sound didn't come through?

DARLENE: Yes, the sound didn't come through.

LEONA: Oh, ok.

DARLENE: Any more questions that people have before we finish off? I think just reflecting at the beginning of your presentation around the 26 different universities that participated, that's absolutely a fantastic number. I'm sure it just shows that students who are blind and stuff are crying out for a better way to receive information in a more accessible way, so that’s fantastic. If there's no other questions, so you've got a couple of claps and well dones. That's always good. There is one. Now they're all coming.

LEONA: Thank you.

DARLENE: So the IRIS, are they interested in students in lower levels in high school, or will those diagrams be too simple for this project? What do you think?

LEONA: The audio is cutting out so I didn't hear all of that question but I think it's designed for higher levels, but it's worth contacting them.

DARLENE: Yep, not a problem. Alright, well that's it for all the questions, except all the wonderful thankyous. Thank you very much for your time and for your presentation and also to your team. Just a reminder that we have another webinar coming up next month, which is actually teaching university students with autism spectrum disorder. It will be showcasing information from a wonderful recently published book that has been written by Kimberley McMann-Coman and Kim Trezama. That will be on 4th April at 1 p.m. More information is on ADCET but we will certainly be pumping out the information because I think that is going to be a fantastic and important topic for the disability advisers and academics and teachers across the sector. So once again, thank you everybody for your time and I really appreciate your time Leona. It was fantastic to hear from you and hear about your project. Thank you everybody.

LEONA: Thank you very much. Bye bye.