Class participation and shyness: affect and learning to program

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Abstract

This paper reports tentative results from a recent case study conducted with novice undergraduate computer programmers. These new computer science students completed a shyness scale questionnaire and were then observed using two kinds of technology that logged their self-rated emotions during their lab-based exercise classes whilst they learned to program using Java. Participants were then interviewed about their use of the technology, their experiences of learning to program and of asking questions within teaching and learning environments. The results here focus on the emerging themes concerning shyness and inhibitions that surround asking and answering questions. It highlights shyness as being a general part of the experience of a computer science undergraduate student, the importance of providing a suitable environment conducive to facilitating questions and answers, and considers how technology might be developed in the future to better support the needs of these students.

1. Introduction

This paper describes a recently completed study examining the experiences of undergraduate Computer Science students learning how to program, and looking at how shyness can affect that experience, particularly with regard to asking questions and seeking help. This particular study forms part of some wider research into how pervasive computing technologies can support shy users, with a particular focus on classroom settings, social situations and public interactive artworks. Presented here are some of the emerging themes/tentative results that will be of interest to those involved in the study or delivery of programming teaching, particularly that delivered at an undergraduate level.

1.1 Studies relating to shyness in higher education

Asking questions is an accepted and often vital part of the learning process. Higher education in particular seeks to provide students with opportunities to critically engage with subjects through discussion, thus facilitating deeper level thinking and knowledge construction. Engagement through debate and small group work is an expected part of university interactive learning experiences, however, research has shown that many students avoid taking part in these types of personal interactions. Howard et al (1996) observed that fewer than 30% of students accounted for more than 80% of interactions within a seminar class. They reported that "quiet" students described four main reasons for non-participation: that the student's ideas were not adequately formulated, that the student did not adequately know the subject matter, had not done the assigned reading, or that the student felt the class was too large. Feelings of looking sub-intelligent to peers were common to male students in particular. Some students reported feeling quite hostile towards students who were perceived as over-contributing, or students who took the class discussion off-topic, whereas tutors appreciated the contributions of students who participated frequently, and evaluated those students more positively.

> **What is shyness?**
> It is most likely to be experienced in novel social settings and when we believe that we will be evaluated by others (Crozier 2001). It can generally be considered an impression management concern and low self-efficacy beliefs about one's social performance (Crozier 2004).

Within higher education there have been a number of studies collecting data about shyness in general and shyness in relation to adjusting to university life (Mounts 2006). However, there is very little work specific to students' shyness, and their experience of higher education. Crozier (2004) examined shyness within higher education at a general level while Crozier and Garbert-Jones (1996) examined shyness within mature students specifically.

Crozier and Garbert-Jones (1996) report on 21 interviews with mature students on a large university course. These students had each completed one full year of university when interviewed. Although only two of these interviewees reported being a shy person, each of the 21 interviewees reported experiencing feelings of shyness whilst re-starting their formal education. For these students, a number of situations evoked feelings of shyness: for example having to speak with a lecturer, or participating in group discussions within a seminar reduced these students' feelings of confidence, and in tandem heightened feelings of shyness.

This relationship between confidence and shyness was described by the researchers as reduced confidence linked to increased shyness, and in parallel increased confidence, leading to a reduction in shyness. Mature students tended to perceive the cognitive and academic abilities of younger students as more advanced, particularly because many mature students took different routes to arriving in higher education compared to their younger peers. Students also report feeling a mismatch between their age and their knowledge levels. The result of these feelings of shyness and lack of confidence led to a lack of participation in their higher education experiences, with students reluctant to ask questions of their lecturers, and participate in seminars. For some students facing up to their anxieties, approaching lecturers, or participating in classes led to them feeling more competent and capable.

They conclude that developing further means for colleges to promote confidence in their students would help to alleviate many of the anxieties experienced by mature students. They argue that tutors should be more aware of their quiet students, and work to create positive opportunities in which those quiet students can contribute.

Crozier (2004) also explored perceptions of the seminar within the wider student population via a questionnaire. Here, the researchers were particularly interested in how much influence students considered their feelings of shyness to have on their participation in seminars. Students reported that quietness in seminars was related to:

- interest in the content
- tutor's teaching style
- student's knowledge of the topic
- amount of reading a student had done in preparation for the class
- students' perception of the teacher's knowledge

For students who self-reported as shy, being quiet in class was most related to reasons such as:

- feeling as though they have nothing to say
- feeling nervous about speaking in front of others
- worrying about saying something silly
- being a shy person
- being easily embarrassed

Shy students also report being more sensitive to personal characteristics of their peers, and in addition to feeling a greater dissatisfaction with their own contributions within a seminar. Again, Crozier argues that tutors should be more aware of what inhibits quiet students from contributing, and structure tasks and lessons appropriately so that shy students know when it is appropriate to contribute to a discussion.

There is some evidence of technology being used to mediate shyness in educational settings such as the "clicker" or Personal Response System (Stowell et al 2010, Lee & Bainum 2007). Stowell's recent study reported on the use of clickers during lectures to reduce conformity in responses to multiple-choice questions amongst students, and to combat shyness. They found that the use of clickers within

a lecture setting did indeed reduce conformity in answers to multiple-choice questions, compared to answering multiple-choice questions with the usual raising of one's hand. Additionally, students who self-reported as shy preferred using a clicker-like tool, to answering questions via raising of the hand.

We knew from the literature that shyness was more commonly reported in male students (Howard et al 1996) and Computer Science-related subjects repeatedly attract a greater number of male students than female. There is also research from Baron-Cohen's group at Cambridge that proposes Engineering and Computer Science subjects have higher representations of people with autistic qualities (e.g. Baron-Cohen et al 1997). These factors make the study of undergraduate computer science students of particular interest in line with the overall Shyness project. We wanted to carry out a case study to explore whether shy non-participation inhibited their experiences of learning how to program and examined this question within a larger study which looked at the use of technology for self reporting emotions in a learning context.

2. Case study: undergraduate students learning to program

This was an opportunistic study and its context leant itself neatly to the aims of the project. The participants were first year undergraduate Computer Science (CS) students at the University of Sussex who are predominantly male, and a mix of younger and more mature students. All CS students take an introductory course in programming Java followed by more advanced courses once they have been exposed to basics principles of programming. This study followed them over their Further Programming sessions during the final two terms of their first undergraduate year.

The overall aim of the study was to explore the emotional experiences of learning to program and, in particular, to examine the use of two types of technology in allowing students to self report on their emotions: EmoSense and the Subtle Stone. The method for the study, and the technologies used, are described in this volume in (Good, Rimmer, Harris & Balaam, 2011). In this paper, we will focus on those aspects that relate particularly to the issue of shyness, and how this impacts on students' experiences of learning programming.

Prior to commencing the study, students were asked to complete an online survey that followed the Revised Cheek and Buss Shyness and Sociability Scale (1981). This allowed for a self-reported shyness score to be captured for each student who wished to participate. All participants were male, from a variety of cultural and educational backgrounds with varying levels of programming experience. Similar questions used by Melchior and Cheek (1990) expected scores higher than 64 to be considered shy: such scores are highlighted in the table below. Participants here have been given pseudonyms rather than using their real names.

Participant	Age	Questionnaire Score	
Mike	19	43	
Robert	19	53	
Joe	34	66	
Doug	19	81	*
Marcus	19	51	
Jack	18	71	*
Mitch	19	38	
Bill	31	49	
Jens	19	64	
Ahmed	21	53	
Carl	19	55	
Connor	19	51	
Darren	20	59	
Richard	20	49	
Raul	26	63	
Miles	19	58	
Toby	20	72	*
Kevin	19	No score at this time	

Table 1 - Participant details. Asterisks indicate shyness scores over 64.

3. Initial Findings

A number of themes emerged from the interview data that will be more fully explored in a longer paper in the future. Below is an overview of the 'shy' themes that the authors felt would be of interest to those researching in the Psychology of Programming field and in particular those who teach programming.

3.1 Problems of uptake

There are 116 students on the Further Programming course and sign-up for this study was very small. There are several reasons why this might be the case. There may have been suspicion as to what would be expected of them in terms of logging or discussing their emotions. Shy students in particular would be unlikely to volunteer to take part or be interviewed about these.

3.2 Self-reporting themselves as confident but really quite shy

The questionnaire scores (presented in Table 1 above) would suggest that overall most of these students were confident. However, during the lab-classes and interviews, trust was gained with several students by the researcher and the student would often reveal much shyer qualities than their questionnaire results would suggest. For example, Connor's score of 51 on the Cheek and Buss questionnaire would not qualify him as shy, but his interview clearly suggests otherwise.

> *"When I was 12 I was very shy, I used to have big problems making friends with people and I'm shy today." Connor*

When asked, students typically self-rated themselves as more shy than the average person but not necessarily any more shy than the average colleague on their course.

> *"I think the overall characteristic of a lot of people on the course is not so outgoing let's say." Mike*

This highlights a problem inherent in self-report instruments. These students were typically recent school leavers aged 19 who may well want to be perceived as confident individuals who are popular and enjoy socialising at parties, but the reality can be very different. At this age, peer groups are an important part of their lives, many attitudes and opinions are yet to be crystalised and this will inevitably affect their levels of confidence.

3.3 Shyness and the problem of asking questions

Previous research by Crozier (2004) highlighted various behavioural manifestations of shyness in educational settings, of which the inability to ask questions was one. It is probably unsurprising that shy students find it difficult to ask questions and as part of our research, we were interested in finding out how widespread this behaviour might be. We therefore included a tick box in the EmoSense tool which was labelled, "I want to ask a question but daren't".

An interesting finding was the disclosure by students that they were too frightened to tick the box to say they were too frightened to ask a question. This was from students who self-reported as confident. They did not want to admit it to themselves and they did not want to be seen to tick this box by others (especially the tutor).

> *"Sometimes I would withhold asking a question, I feel shy about putting that on EmoSense, if I was thinking about a question, even then I'd feel shy about ticking that." Robert*

> *"I wasn't really sure what would happen if I did tick it, whether an alarm would burst up flashing in your office and you would ring up here and say [to the tutor], 'Jack wants to ask a question, go and ask him what it is.'" Jack*

Several examples were offered which described the problems associated with asking questions. These included not knowing when it was appropriate to ask a question, for example saving it for the lab class rather than in the lecture. There was a common fear of asking the first question and whether it would

be right in terms of appropriateness and language used. Judging the reaction to a previous question asked by someone else allows the student to calibrate his own.

> *"I remember once I tried to ask something I didn't understand, even the teacher, he didn't understand what I was trying to get at, he said to me, ' We'll get to you later' and 'Okay'. But it's like obviously I needed to understand it now to carry on with it overall, but it didn't happen." Raul*

This particular course was titled Further Programming, indicating it as a more advanced level of programming. Many students still felt very new to programming in general and perceived that their own efforts were not up to the standard implied by the advanced course title. During lab classes, many students described a reluctance to allow their onscreen code to be visible to the tutor when he walked past and several strategies of deflection were described. Some welcomed the general class noise which covered their own voice when asking a question thus shielding them from unwanted attention. They would minimise the screen when the tutor walked past, avoid eye contact or even, in some circumstances, simply not turn up to class. Some feared that they might be the only student in class who had not got to grips with particular concepts and if they wanted to ask a question, felt they did not necessarily have the vocabulary to articulate or express what they needed clarifying.

> *"I don't know. I'd be sitting there and I'd be stuck and maybe I'll look at the lecture slides to see if I could understand it. I don't really understand it. I think if I call Tom [lecturer] over, then he might sort of say, 'It's in the lecture slides, look at the lecture slides'. 'But I do not really understand the lecture slides'. 'How can you not understand the lecture slides?' Then he might explain it again and it wouldn't be very helpful and then I'd be too scared to say I still don't understand it after he's given me a big explanation. And then I think it probably won't help anyway if I'm too scared to say I don't really understand again. So I probably wouldn't bother." Jack*

Another issue which is likely to affect shy students more acutely is the need to build up a relationship with another person before they are comfortable asking them for help. Not being familiar with others on the course was reason enough not to ask for help or even clarification.

> *Interviewer: "Would you ask someone sitting next to you?*
> *Depends on the person and if I've spoken to them before or not…A lot of the more confident people, the younger guys ask me a lot of questions. They've figured out I know my Java." Doug*

> *"I know one person that I know I could approach because I have spoken to him a few times about Java." Robert*

> *"If I knew them, I'd have no problems. …[If not] I probably would eventually if I was like really stuck and I really didn't get it and they seemed like quite a friendly person. I'd probably eventually sum up the courage after an hour or so, 'Excuse me, can you help me? I'm stuck.' But I don't know." Jack*

Large lectures, with over 100 students, are also not conducive to asking questions, and require a confidence that most undergraduate computing students don't possess. However, as the last quote shows, even in sessions specifically designed for question and answer exchanges, the reluctance still persists.

> *"In a class of like 30 people, I'd feel happy to put my hand up. In a class of 110, it's got to be something quite severe to put my hand up. If it's just a little question, something that you're not quite sure of, you don't ask that with a hundred other people there." Mike*

> *"But then, the other thing, there's a question and answer session and we get there, and there are two people that put their hand up. That's especially for people to ask questions. So it just goes to show that even when you've got that, people don't really want to put their hands up." Joe*

One very interesting finding was that it would appear that a culture of question asking, or rather not asking, had grown up in the lectures, which made it difficult, particularly for shy students, to run the risk of asking a question:

> *"As far as questions go in lectures, it's still oddly frowned upon. Somebody would just get angry when someone asked a question, because it's as if something that's so obvious to someone else is going to be just as obvious to other people. I always find that interesting. Other people I've come across . . . other people who then get very angry at the people that are getting angry at the people that are asking questions. I'm just enjoying that whole thing "* Mitch

> *"But one of my friends, he gives nicknames to everybody. One person has got like 'inappropriate question man' because he always asks inappropriate questions and stuff like that. I think it's good when people ask questions. It just doesn't happen a lot. That's all."* Miles

> *"Sometimes I sat a seat apart from people just swearing at the person [asking a question] or even miming loading a gun on one occasion. ...Some people were just like, 'Oh dear, dear me, how could you ask such a... I don't know'"* Mitch

Another factor reported by students that inhibited their ability to ask questions was the perceived unapproachability of several tutors. The University environment is less familiar to students having come from school. It is typically a larger campus with greater student numbers, a lot more strangers surround them, they experience a complicated network of corridors when they are trying to find a tutor and they often report not knowing what the protocols are, such as how to address a tutor (sir, doctor, professor or first name?). All of these factors can have a significant impact on their confidence that can in turn affect their performance in class.

> *"I'm not entirely sure how we're supposed to address our lecturers. Like Tom, I'll just call Tom. But some people have called the lecturers 'Sir' or whatever. So if it's a different lecturer, like Peter Thomas who I've not really got a relationship with like Tom, I wouldn't say, 'Can you answer this, Pete?' You say, 'Professor Thomas'. Who knows?"* Joe

> *"I thought about doing it some times. Going to have to knock on their door seems quite daunting. Knock, enter, go in and say, 'I need some help, I'm a little bit stuck'. If you ask the question and I think like it might be a really stupid question and they might be 'Ah, you don't get it.'"* Jack

> *"Some, I think, they take things more formally and seriously. That might be a bit more difficult to ask questions. But usually when you get to know them a bit, it's much easier because you realise they're not like any supreme beings. They're just human."* Ahmed

3.4 Shyness and the problem of answering questions

Asking questions proved problematic to many of the students we interviewed, however, answering questions was just as difficult. Many lecturers pose questions to students in an attempt to encourage more interactivity in their lectures. However, this technique, when combined with the underlying culture of non-participation remarked upon in the previous section, often fails:

> *"...another case for this is shown when the lecturer asks simple questions to try and loosen things up. No one wants to answer the simple question. I don't know why that is. But certainly, 'Do you have any questions?', no one wants to have a go. No one wants to."* Mitch

> *"In fact what happens is the longer that question lies open, sometimes the lecturer will want an answer to this question, so they'll just stand there as if, 'I'm not going to let this go'. But the longer they leave it, the awkwardness grows larger and larger and no one wants to break that. There's some psychological . . . it's worse now. I could have put my hand up and it would be better to have answered it straightaway than now we're half an hour away and no one is going to say anything."* Mitch

And just as students do not want to risk asking the 'wrong' question, they obviously do not want to risk getting the wrong answer:

> *"I have answered a few questions in lectures. But if you've got it wrong . . . I have answered questions and got them wrong . . . it depends. If the question was hard, then you don't feel so bad. If it was easy, then you know that at least 5 people in there have gone, 'You idiot, moron.' There is at least a perceived risk in my head when it comes to answering questions."* Mitch

> *"I think if I knew the answer then I would not answer it as well because I'll let someone else do it. I'm not really a native speaker so I would feel embarrassed if I made a mistake or gave the wrong answer, or say it wrong and I'd feel myself go red in the face."* Jens

Finally, lecturers often try to gauge student understanding of the material presented so far before moving on to new topics. Although this is clearly desirable from a teaching perspective, it also often fails for the same reasons: students don't want to publicly acknowledge their lack of understanding:

> *"Plus another thing is they say, 'Does anybody understand?' and nobody answers and then they assume that everybody does. But everybody, like all of my friends, I was like, 'Did you understand that?' and they're like, 'No'. We should have put our hands up and nobody has got the guts to actually put our hands up, which I'm not sure why really."* Miles

> *"In lectures, even when the lecturer . . . most of them do this: they'll say, 'Do you have any questions?' No one says anything. No one will ever say anything. Maybe someone will, maybe because that person is strange and doesn't care about what anyone else thinks. But a lot of the times no one says anything. Even if everyone knows that everyone else including themselves has no idea what has just been said, they won't."* Mitch

3.5 Computer Science and problems of asking questions

One of the most striking issues was that several students reported hyper-vigilance around asking questions at the start of the academic year that became a little more relaxed as the course progressed. This was a fear of asking questions that might be construed by the university as collusion with another student. Computer science students in particular are heavily warned against plagiarism and collusion at the start of the academic year. This therefore inhibits them from asking questions.

> *"...the only person you're allowed to ask for help, which isn't collusion, is the lecturer."* Miles

> *"In the first term… if we were stuck on the coursework, I would say, 'I'm quite stuck' and my friends would say, 'We can't really help you, that's colluding'. But now in this term, they say, 'I can give you a couple of hints'. Like we don't sort of say, 'The answer is 1b or 7 or whatever'. They sort of say, 'You should try looking at this website or maybe you haven't really done that quite right'. But I wouldn't say that was collusion."* Jack

> *Interviewer: "It's perfectly fine if you're struggling in a lab class to ask someone a question, a colleague can say, 'Oh yeah, you need to do this or think about that'.*
> *Miles: "Yeah, but that's even classed as collusion as well. I think collusion is absolutely ridiculous. Plagiarism, I think that's fine. Collusion, it's just gone too far really."*

Although it's clear that plagiarism, and collusion, are serious issues in computer science teaching, it also seems important to ensure that collusion does not become a barrier to peer collaboration and support as appropriate. Many of the students we interviewed mentioned that they often preferred to ask a peer for help rather than a lecturer, given that they had built up a relationship with their peer and therefore felt less anxiety about whether their question might be perceived as trivial.

> *"So I actively try to get to know people because then you get support from them and can ask them questions as well. I think it's easier asking questions from your colleagues and stuff like that, even if it's a stupid question, it's definitely easier."* Ahmed

Furthermore, students mentioned the fact lecturers' responses are not always pitched at the right level of abstraction, whereas their peers may be able to explain things using a language and terminology that is more familiar to them.

> *"If I didn't know generally, I'd ask a classmate first and then ask Tom [tutor], because I felt, ask the question at the same level with a classmate and say, 'What is this?' and say it quite bluntly and say, 'I don't understand it'. Whereas if you ask Tom something, it's quite hard to articulate what you're actually troubled with and what you need help on."* Robert

> *"But there's some difficulties for me. Like sometimes it's hard to understand because either the accent of the tutor or either . . . they're using sometimes really, really academic and phrases that even if look up in a dictionary, I won't find it."* Rami

4. Implications and Further work

Although a thorough analysis of the transcripts and related data remains to be done, emerging themes indicate that these Computer Science students' educational experience suffers as a result of shy feelings. Of particular relevance is the inhibition surrounding asking questions. These findings confirm previous research into shyness in higher education and allow us to better explore how teaching practices and the use of technology might reduce some of these inhibitions.

This work demonstrates the need for teachers of computer science to aim to provide suitable environments within which students feel comfortable and uninhibited to ask questions. At the same time it is also important to recognise that many students may feel shy or inhibited when asking questions and therefore may need other means to do so. We know that familiarity with peers is likely to increase the chances of students asking questions of them but that there is a fear of any questions being viewed as collusion. Tutors should try to explain the differences between collusion and plagiarism, and what sorts of questions and answers are acceptable between students. Although it's clear that peer support is important, lecturers should also ensure that they are approachable, and should make an effort to know their students (in our interviews, many students highlighted how important it was that a lecturer knew their name). Lecturers should also be mindful of how they are couching their answers, realising that for many students, asking a question can create considerable anxiety in the first place and if they don't understand the answer, they are unlikely to seek further clarification.

It is proposed that our next round of studies will look at gathering emotional states from the class as a whole and to consider how these might be used in an external representation (such as a projection on a wall). This may help the student realise that they are not alone in their non-understanding and it also could allow the tutor to make changes to his teaching approach on the fly. Care will, of course, need to be taken to avoid further isolating an individual feeling like the sole person in the class who is, for example, confused. The tutor might utilise these sorts of logs to iteratively adjust their teaching, noting weaker areas for further clarification as needed (or even for later testing).

Although clicker devices are very simple technologies which are already in widespread use, they may potentially have a marked impact on computing lectures. Given that students are reluctant to put their hands up to let the lecturer know they haven't understood a concept, clicker devices could be used instead so as to provide this feedback anonymously. This would allow the lecturer to know whether the majority of the class had understood a concept, and they could be used more generally to ensure that the lectures were being pitched at an appropriate level. They might also be used in lab classes to discreetly alert the tutor that a student wishes to ask a question rather than have them raise their hand or call him over, thus diffusing any attention that might be placed on the individual student.

Next term the aim is to invite some of the students entering their second academic year, who used EmoSense and the Subtle Stones, to participate in some design exercises to look at the technologies available and how they might be best utilised in a learning-to-program environment. These will then be trialled with the new cohort of first year undergraduate Further Programming students to explore what effects they may have.

5. Acknowledgements

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