# Aspects of Graduateness in Computing Students' Narratives

Sebastian Dziallas
School of Computing
University of Kent
Canterbury, CT2 7NF, England
+44 1227 827684
sd485@kent.ac.uk

Sally Fincher
School of Computing
University of Kent
Canterbury, CT2 7NF, England
+44 1227 824061
S.A.Fincher@kent.ac.uk

## ABSTRACT
In this paper, we explore graduates' characterisations of their learning experiences at university and beyond. Using a narrative methodology, we elicited life stories from graduates of the School of Computing at the University of Kent. We initially review and situate our approach within the wide variety of existing narrative approaches. Then, we turn to an aspect of the student experience that struck us as particularly significant: the "year in industry". We discuss the accounts of ten participants who completed a year in industry and highlight their perspectives of the effect it had on them. Finally, we propose a narrative construction of the concept of graduateness – of what it means to complete a university degree.

## Categories and Subject Descriptors
K.3.2 [**Computers and Education**]: Computer and Information Science Education – *curriculum, computer science education.*

## General Terms
Human Factors

## Keywords
Narrative Methods, Qualitative Research, Graduateness, Year in Industry, Turning Points, Boundary Objects

## 1. INTRODUCTION & GRADUATENESS
> *"The past and the present live alongside each other in our working lives, overlapping and intertwining, until it is sometimes hard to know where one ends and the other starts." [51]*

University reflects a profound time of individual development for people not only in terms of disciplinary knowledge and skills, but also in terms of their personal growth. Research on the specific effects of college has filled volumes; many of these studies are quantitative in nature and follow a positivist research tradition. [47] Some reports, such as the *Browne review*, have focused on the benefits of higher education in terms of employment opportunities, income, and health outcomes. [9] Other studies have explored claims of university as a means for social mobility. [25, 41, 60]

In the UK, the discussion about the effect of university is often framed in terms of "graduateness". According to Glover et al., graduateness can be "defined as the effect on knowledge, skills and attitudes, of having undertaken an undergraduate degree…." [20] However, the question of *which* attributes should be considered for graduateness has been the subject of many debates. When the UK Higher Education Quality Council released a discussion paper to determine the "attributes of 'graduateness'" in 1996, a particularly exasperated response in the *Times Higher Education* noted: "This is sheer speciousness. …there are good reasons for challenging the assumption of one immutable model of higher education to which all institutions should aspire." [24] Yet, existing research has largely focussed on an aspirational list of generic capabilities to be achieved by students regardless of discipline. [20] Students are held to have more or less graduateness when measured by generic instruments such as the *Reflective Thinking Questionnaire* and *Motivated Strategies for Learning Questionnaire*. [58] In contrast, for this study, we are interested in students' own conception of their education to capture their characterisations of what it means to undertake a computing degree.

## 2. METHODOLOGY
### 2.1 Characteristics of Narratives
In this study, we adopt a narrative methodology. Narrative approaches represent a wide range of practices across different disciplines, and are commonly used in psychology, sociology, anthropology, and oral history. [27, 42] As well as disciplinary diversity, narrative methodologies also reflect different methods: some approaches elicit narratives through interviews (e.g. [39]), while others examine individual speech acts (e.g. [7]), and others again focus on century-old folklore and tales (e.g. [29]). As different approaches conceptualise the terms *narrative* and *story* differently, we first look at existing definitions and establish how we use the terms in our research and throughout this paper.

Although there is little agreement on a canonical definition of the term *narrative* [48], the central feature of a narrative as a series of events being recounted, remains characteristic across domains. Labov, from a sociolinguistic perspective, defines a *minimal narrative* as "as a sequence of two clauses which are *temporally ordered*." [30] Sarbin, a psychologist, highlights the role of


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narrative in organizing "episodes, actions, and accounts of actions." [52] And Adler points to an emerging psychological consensus that narratives are "composed of structured reconstructions of events that describe characters and their shifting intentions over the course of time." [1]

The term *story* is sometimes used synonymously with narrative, but there are important differences between the two: a story is a specific form of narrative. Its major events form a *plot* and it generally has a setting and characters, as well as a narrative arc with beginning, middle, and ending. [48] A story can also deploy literary devices, like climax or *dénouement*. The focus of a story lies with the actors, their actions, and the consequences. As Cheryl Mattingly observes, stories "are about someone trying to do something, and what happens to her and to others as a result". [33]

However, certain forms of narrative, whilst chronologically arranged, do not or cannot draw on elements of story in their construction. For example, when writing a diary, the author cannot know what is going to happen next, cannot give additional significance to an event than it has at the time it occurs, and so cannot place events in a dramatic arc. [18] We call such narratives *non-storied*.

## 2.2 Narrative Analysis

The wide range of narrative approaches and their application in different disciplinary traditions has resulted in an equally wide range of analytic strategies. Figure 1 represents different structural characteristics and analytic approaches to narrative, and situates our work within them. Figure 1 is structured to position narrative artefacts as data and is constructed from the researchers' point of view. We believe this is a useful framing, but also recognize that it necessarily simplifies the considerable variety of work in this area. The approaches mapped in figure 1 do not, for instance, represent categories such as the content and structures of narratives, the act of telling stories, or societal and cultural influences on the stories being told; three axes identified by Holstein and Gubrium that are orthogonal to our mapping. [27]

In figure 1 the horizontal axis delineates characteristics of the narrative artefact itself, from storied to non-storied. At the storied end of the axis are accounts for which interpretive elements such as "the journey" or "turning points" are integral. One example here is the life story (which we discuss in detail below). On the non-storied end of the axis are narrative forms such as diaries.

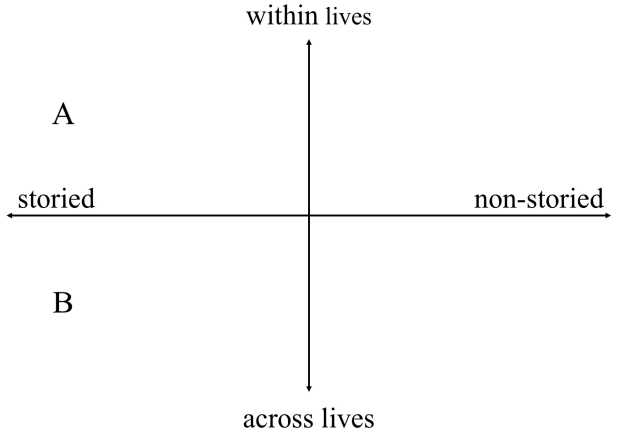


**Figure 1. Different Narrative Approaches**

The vertical axis does not describe characteristics of narrative accounts, but of their analysis (and so also has epistemological implications). On the one end, analysis is concerned with preserving the individual, specific nature of the material even if researchers may set it in a wider thematic or theoretical context. At the other end, analysis is concerned with finding similar elements across many accounts (lives) which then become data for an argument, a thesis.

We illustrate the quadrants of figure one with examples of different narrative approaches, although the fact that we locate an example in one quadrant does not mean that a researcher is confined there: they may have taken different approaches in other work.

In the top-left quadrant research is concerned with the stories people construct and the larger trajectories those stories contain. For instance, in his work on narratives of craft workers, Elliot Mishler adopts a case-centered approach to explore similarities and differences in individual narratives while maintaining their integrity. [44] He writes:

> "The distinctive feature of this approach, and its fundamental requirement, is that individual trajectories of change are retained through all stages of analyses. Findings, therefore, do not refer to measures of variables aggregated across groups of individuals but to similarities and differences among intra-individual or intra-case patterns of change…." [44]

McCartney and Sanders have employed a similar approach in their report of a longitudinal study of computing undergraduates. They justify their use of the approach by quoting Reed Stevens.

> "Stevens et al. explain their choice of a similarly narrative approach by saying that they want to "get at the whole person's experience ... to recover engineering students moving through their undergraduate educations" and capture "their individual pathways and experiences as engineers-in-the-making." [59, pp. 355-356]" [40]

In contrast, the top-right quadrant focuses on authentic details without necessarily being concerned with larger trajectories. Research in this quadrant is exemplified by the 1940's UK Mass Observation project which, for decades, sent questionnaires to its participants and regularly elicited responses to "day surveys" (in which respondents detailed their activities on the 12th day of each month). The Mass Observation reports provide insight into the individual circumstances of the respondents' lives. Annebella Pollen quotes historian James Hinton, who observes:

> "The more you try to use the writing of individual respondents as a basis for generalisation, the more you are forced to put to one side precisely what it is that MO [Mass Observation] can best reveal: individuals struggling to make sense of their lives. … Individual subjectivity is always more complex than generalisations about the life of the group. Every person does it differently; and the more one knows about any particular individual, the less they can be used to illustrate some more general experience or theme." [50]

Much of CSEd is engaged with teachers and learners making sense of learning. Colleen Lewis in her microgenetic analysis of student debugging focuses on the individual narrative of one student's engagement with debugging. [31] Rather than following

a particular individual, some researchers choose a narrative incident as their focus. Deitrick et al. describe the learning of a pair of middle school students through their non-storied discursive engagement with programming. [15]

In the bottom-left quadrant are approaches that deal with multiple accounts, but accounts which concern themselves with storied reports, made meaningful by the contributor. For instance, Dan McAdams discovered an overarching theme across many life story interviews with adults who showed particular concern for the well-being of the next generation (as described by psychological measures). These adults often told stories containing *redemptive sequences* in which "bad" scenes - that describe negative circumstances - turn out well in the end. [39] As part of this work, McAdams and colleagues operationalised a definition of redemption sequences into a coding scheme which they used to develop more generalizable findings. Yet, as Adler and colleagues observe, work in this quadrant is not removed from the original narratives.

> "Although researchers have developed approaches for streamlining the work, conducting narrative research fundamentally involves a deep immersion in participants' stories, working to tease out their meaning in a valid and reliable way." [2]

Storied approaches are not common in CSEd, but Guzdial and Tew made an explicit examination of storied construction of pedagogic design in their early work on Media Comp classrooms. [21] And Mike Hewner's work investigating how students make course choices relies on the expression of personal and curricula trajectories. [26]

In the bottom right-hand quadrant, researchers gather data from many sources, in a variety of ways, and work to find meaning across them that may not be evident from any single account. Beatrice Webb details this sort of analysis as central to investigation in social science "The simplest (and usually the least fertile) way of expressing the results of an investigation is to follow the strictly chronological order in which the events occur." [61] She describes the necessary work of breaking down narrative data "... to isolate and examine … its various component parts, and to recombine them in new and experimental groupings." [61] More recently, Teresa Amabile and others gathered and broke apart responses to 12,000 daily questionnaires to predict what events affect the experience and performance of members on project teams. [4] And while Amabile and her colleagues acknowledge differences in how individual study participants experience events at work, their approach relies on collecting a broad sample of "frequent brief reports from many individuals across time." [5] An example of work in CSEd in this quadrant is an extensive study by Lister et al. examining novice programmers' reading and tracing skills. In interviews for that study, students were given a set of multiple choice questions and asked to "think out loud" as they worked to answer the questions. [32] This resulted in a collection of spoken and textual narratives, as Lister and colleagues also captured students' code traces (which they call "doodles"). These narrative fragments are temporally ordered accounts and describe students' actions; but they are, of course, non-storied.

There is an additional aspect to figure 1, which draws on the epistemological element of the vertical axis. Those researchers who work *across lives* (in the bottom half of figure 1) aim to make decontextualized and generalizable statements to establish an objective truth. Methodologically they work to seek, describe and compare quantifiable elements (such as affective, motivational, or integrative themes [2]) across many narratives – and in doing so, habitually devise and apply coding systems and aim for high inter-rater reliability ratings in testing their hypotheses. At the other end of the scale (in the top half) researchers focus on the idiosyncrasies of a life in context in analysis that "deals in human or human-like intention and action and the vicissitudes and consequences that mark their course." [11] Researchers here engage with the individual and particular and are not concerned with an objective "truth" of events, but rather with the sense people make of them. Methodologically, they often rely on the relationship of researcher and subject, the identification of emergent themes, and frequently explore individual cases in detail. Alongside these differences of method and approach, the form that researchers choose to report their work also differs. Researchers in the top half of figure one most often use a *narrative mode* of presentation such as case studies and comparisons. Researchers in the bottom half typically use numeric, or statistical presentations in a *logico-paradigmatic mode*. [11, 49]

## 2.3 Narrative Identity

In this work, we are concerned with storied narratives. A number of researchers connected the notion of storied narratives to the concept of identity. Hammack, for instance, draws on aspects of cultural psychology and writes:

> "Identity is defined as ideology cognized through the individual engagement with discourse, made manifest in a personal narrative constructed and reconstructed across the life course and scripted in and through social interaction and social practice." [23]

In another model, Sfard and Prusak "equate identities with stories about persons" and write that these stories that form one's identity must be "reifying, endorsable, and significant". [53] In a commentary on their work, Mary Juzwik distinguishes the terms narrative and story and draws on previous research establishing a connection between *identity* and *story* through the concept of the *life story*. The life story reflects who a person thinks they really are and includes narratives from across contexts of their lifetime. [28] Juzwik incorporates this concept into Sfard and Prusak's framework. Rather than viewing a person's identity as a collection of undifferentiated stories, she argues that "reifying, endorsable, and significant" stories become part of a person's life story, which in turn forms one's identity. [28]

The approach we take in this work also focuses on the *life story* (situating it on the storied end of figure 1). However, as with narrative, the term life story also encapsulates different approaches. According to Plummer, a life story is broadly an "account of one person's life in his or her own words." [48] (He describes different kinds of life stories in [48].) In our work, we follow McAdams, who argues that people construct stories to make sense of their lives and integrate these stories into their life story, which is part of their personality. McAdams describes differences in personality through a three-level framework. [38] Broad dispositional traits, such as conscientiousness and neuroticism, form the first level and remain relatively stable over the course of a lifetime. [14] These, however, only provide what McAdams calls a "psychology of the stranger" – a rather generic view of a person. The second level consists of personal concerns, motivations, and goals which are contextualized within time and place and thus change over time. Finally, the third level is the life story. For McAdams, we continually revise the life story as we

"weave together the reconstructed past, the perceived present, and the anticipated future". [3] These stories are at the core of who we are and provide the self with unity and purpose. [35]

The emergence of a person's life story is linked to their identity development: younger children between the ages of 5 and 10 – whilst capable of telling coherent stories of single events – do not construct life stories that integrate past, present, and future. [22] By the time they reach high school, however, this has changed. McAdams et al. interviewed college students and found that they were able to tell coherent life stories. In fact, when they interviewed the same students again, they discovered that their life stories exhibited thematic continuity over time. [34]

# 3. THIS STUDY

We collected life stories from graduates of the School of Computing at the University of Kent (a medium-size public research-focussed, PhD-granting university in the UK) to explore how they make sense of their learning experiences. We recruited participants via email through the alumni office at the University of Kent and invited them to indicate their interest in reflecting on their learning experiences. We then conducted interviews with 35 people who had attended the School of Computing. We used the following prompt, which was originally developed by Dan McAdams as part of his own work on life stories and which we adapted to elicit participants' reflections on their learning experiences. [36] The interviews were then professionally transcribed and pseudonymised.[1]

> *I'd like you to think about your learning career, your learning 'life', as if it were a book. Each part of your learning composes a chapter in the book. Certainly the book is unfinished at this point: still, it probably contains a few interesting and well-defined chapters. Please divide your learning 'life' into its major chapters and briefly describe each chapter. You may have as many or as few as you like, but I'd suggest at least 2 or 3 and at most 7 or 8. Think of this as a general table of contents for your book. Please give each chapter a name and describe its overall contents.*

These interviews form the basis of a larger study that aims to characterise graduateness in computing education by exploring graduates' individual narratives (located at point A in figure 1). In this paper, however, we chose to explore the experiences of a subset of our participants, as we were struck by a common element in their narratives. For these students the "year in industry" played a significant role in their story. In terms of analysis, in this paper, we aim to make some generalisable statements about graduates' narrative construction of graduateness (located at point B in figure 1). Methodologically, Elliot Mishler notes that working in the positivist tradition loses "… the pattern, form, and structure of trajectories of development" which we are particularly interested to preserve in this work. [44] Pascarella and Terenzini similarly observe that "rendering tone, tint, texture, and nuance [of the college experience] may require the finer brushstrokes characteristic of qualitative approaches." [47] The work we present is here is then distinctly qualitative.

[1] We use pseudonyms throughout this paper for both the names of our participants and the companies they worked at. For each participant, we also denote their graduation year next to their name the first time we quote from their interview transcript.

# 4. CONTEXT: KENT & YEAR IN INDUSTRY

All practice-facing disciplines share educational challenges of how – and how much – to incorporate professional practices into the curriculum, and they vary in their approaches. Medicine (and associated subjects with clinical components, such as Nursing and Dental Studies) will incorporate "clinical rotations", where students go out into hospitals and work within a variety of specialities. Law departments often establish in-house "law clinics" where students work *pro bono* on cases alongside practicing lawyers. Computing's approach has tended to be to interleave industry experience into the curriculum through "fully immersive" experiences [17] where the student leaves the educational environment entirely and works within a professional environment for a period of time. Cooperative placements (a semester in University, a semester in work), internships (a limited-time placement, often during the Summer vacation), or "sandwich" years (the third of four years spent working in industry) are all common models. During these times, students work for and are employed by an external company. In the UK, placement programmes commonly follow the sandwich model.

The placement year program at the School of Computing at the University of Kent was initially established in the mid-1980s. By the early 1990s the "year in industry" was reflected in graduates' degree titles. Changes in the structure of the year in industry program in the late 1990s, when a new head of school hired dedicated staff, led to an increased number of participating students. As a result of these changes, the placement program within the school is unusually strongly structured. [19] The school's dedicated placement office works with students on an individual basis and helps with the preparation of CVs, applications, and with interview practice, gives talks and presentations throughout the curriculum, and visits students during their time on placement. Upon returning from their placement year, students deliver a poster presentation about their work experience to faculty and students in the school. Today, 70% of all students pursuing an undergraduate degree in computing at the university complete a year in industry. [19] The high number of students and the dedicated support mean that there is an expectation from the beginning for students consider a year in industry.

# 5. CHAPTERS & SELF-SIGNIFICATION

In a comprehensive review of existing studies, Habermas and Bluck identify four types of coherence that provide unity within the psychological construct of the life story: temporal, causal, and thematic coherence, and the cultural concept of biography. [22] The latter accounts for differences in how members of different cultures recall autobiographical memory (e.g. with a focus on the individual or the community). [13] Habermas and Bluck write:

> "Temporal coherence and the cultural concept of biography are used to form a basic, skeletal life narrative consisting of an ordered sequence of culturally defined, major life events. Causal and thematic coherence express the unique interpretative stance of the individual." [22]

That is to say, regardless of the chronological sequencing of events, the way a person constructs connections in their narrative reflects their own perspective and the sense they make of the events being recounted.

Our method of elicitation foregrounds temporal and thematic coherence. Temporally, almost all of the participants divided their "learning life" chronologically into chapters according to the schools and university they attended and the jobs they held. One of them noted explicitly: "So I really saw my chapters just as kind of like stages of school." (Alex Barlow, 2013) For them, each new chapter coincides with, and indeed describes, a transition to a new environment. Others followed a largely chronological order, but include chapters with a particular thematic focus. Table 1, for example, contains the chapter titles from our interview with David Bruce.

**Table 1. Chapter Titles for David Bruce**

| | |
|---|---|
| 1. Early Experiments | 8. The Kindness of Strangers |
| 2. Secondary School | 9. Yaveo |
| 3. The Computer Science Degree | 10. Going Independent |
| 4. Volunteering with the Student Union | 11. Contractor Roles I've Known and Loved |
| 5. Working at Jalia | 12. Things I've Learned from Teaching |
| 6. Stuff I Picked Up from the Internet | 13. Mistakes I Have Made |
| 7. Little Life Lessons | 14. The Future |

Summarizing and interpreting stories are two cognitive skills central to the development of thematic coherence. [22] In inviting participants to name the chapters we invite them to express their own interpretation through a form of *self-signification*. David Snowden observes: "I often talk about self-signification as adding layers of meaning for good reason. The content of the narrative is only a part of the meaning that the contributor can supply, the way they interpret is also key." [54] The act of naming then reflects the interpretive stance of the narrator, rather than that of the researcher. [55]

In our study, one participant described his early foray into electronics in one chapter:

> Then … the next one is going to be, possibly GCSE [secondary education certificate examinations in year 11] and possibly a little bit later where I actually diverged away from computing again. I went into electronics. Because I'd done computing [in school], I couldn't then carry on with it so I went into electronics and really enjoyed that for the next couple of years. … We just happened to have a teacher [who] …offered a GCSE. There were about 20 of us that did that. (Joe Stewart, 2012)

Which is easy to read as a positive and productive experience. But when asked to name the chapter, he responded:

> That's … the diverge away from computing so … maybe *"a distraction"* or something, I don't know. I went on a slightly different course. (Joe Stewart)

This form of self-signification can reveal meaning participants attribute to an experience beyond its mere description: unlike the term diverge, a "distraction" suggests a negative connotation that was not previously apparent to us as researchers.

As we reviewed the chapter titles, we noted that almost all of the graduates who had completed a year in industry had separated it into a new chapter.[2] In many cases, they were entitled "the placement year" or "working at Jalia". These titles reflect the next step in the temporal sequence of stages during university. But for some graduates, they also indicate the type of experience they had: the kind of company they worked at (for instance, a startup or a small business), the geographic location, or the fact that they returned to the same company post-graduation (in the case of "Jalia Part One or USA").

**Table 2. Year in Industry Chapter Titles**

| | |
|---|---|
| The Placement Year | Working at Jalia |
| The Placement Year of the Startup | Year in Industry |
| Working for a Small Business | Welcome to the Real World |
| Applying Computing to Industry | Jalia Part One or USA |

Indeed, the terms *placement year* and *year in industry* serve as a catch-all for many different kinds of experiences: the people we interviewed worked at large consulting firms, smaller IT businesses, start-ups, and open source companies – and some of them spent time working in foreign countries. Of course, each of these experiences is different in its own way, but there are also similarities. A year in industry is a transition for everyone who undertakes it. But for some, it forms a more significant part of their life story.

# 6. EFFECTS & PERSPECTIVES

The effect of the year in industry experience emerged in our interviews with participants, rather than in the individual chapter titles.

> I think to be honest, that the placement year is pretty fundamental for where I am now in my life…. (Nathan Baker, 2013)

For some students, it provided insight into the kinds of work they wanted to do after they graduated.

> Well, it showed me what I *didn't* want to do after I graduated. I was a tester for a small Java company, and although I found it interesting finding the bugs, it wasn't really something that I wanted to go into. (Alice Hayes, 2007)

> People always say, don't they, "A year in industry, that made me decide I definitely wanted to [do *x*]." … For me it was, "Yes, I *don't* want to go into industry, certainly not yet." (Joe Stewart)

> It made me realise that start-ups are crazy and that it's a problem when you have no money. You have to go and chase money and what you do doesn't really matter. (Joel Bailey, 2012)

[2] Of the two participants who did not do so, one had deliberately not sought new work, but continued previous freelance work during his placement year. And the other spoke more generally in terms of his chapters: "I guess each chapter is marked by a clear end, but in my case, that would be the graduation. So like the beginning of the summer and going into the next, taking a break and then going into the next stage." (Alex Barlow)

There was also a sense that most students returning from their year in industry (though not all, as we discuss below) approached the final year at university in a different manner.

> … and if I hadn't have done that [the year in industry] I dare say I would probably gone down a very different path. Just in terms of how seriously I took that final year and how hard I worked…. (Nathan Baker)

This transformation of attitude was apparent even to students who did not complete a year in industry themselves.

> Quite a few classmates did do that [a year in industry]. In hindsight, now, I wish I had done it. I wish I had done it. The people that you saw, you met them in what would have been their fourth year, my third year, they work *differently*. (Emily Briggs, 2009)

In their study of recent college graduates in their first jobs in software development, Begel and Simon found that "many of the social and communication problems … were rooted in the anxieties of working on a large team with a large, legacy codebase." [8] Our participants spoke vividly of their interactions with these large codebases.

> … having to get to grips with the monstrosities that they have come up with. Because some of this stuff was just insane. Design decisions that no one could agree with. It was just out of this world. (Jake Mason, 2015)

> … then you go to something like this where there's this mess of other people's code, and it *kind of* works, and there are bugs, and you've got to make it do this thing. Yes, overwhelming I guess, was a word that I'd use. (John Warren, 2012)

At the same time, the work they were doing was often under tight deadline. Students were keenly aware of the differences between academic and workplace deadlines and the consequences of missing deadlines in their new context.

> Your time management is so much better. Because if you don't deliver something for your boss on time, then he's going to be fucking pissed. (John Warren)

Part of the experience that participants commented on was their adaptation to the workplace and the development of time management skills which they then employed upon returning to university.

> The first few times it happened – "Oh shit I've got two hours to fix this." And then towards the end you approach it very differently. You don't go into this blind panic of, "Aaargh. Deadlines. Deadlines." No, you sit there, you break it down, you manage your time and you get the job done. (Nathan Baker)

> And so by third year, coming back after a year of working, it just completely changed my mentality. I was like, yes, this just needs to get done. I just need to set out a plan. Work out a weekly schedule, make sure I do the coursework early, and I worked out how much I needed to get in each piece of work to get the grade. (Alex Barlow)

Students also returned to university with newly developed presentation skills and experience of working with others on teams.

> So, after your sandwich year, you give a presentation. I gave a good presentation, because Jalia had trained me in presentation skills. (Nicholas Bradley, 2002)

One graduate, David Bruce, described his good experience of working on a team and how he realised the importance of team roles and good leadership.

> So that was something that I appreciated. The value of a good project manager, as a result of that year in industry and what they can do. (David Bruce, 2006)

He also reflected on the importance of communication skills when working on teams.

> [Before] it was like, "That doesn't matter. I'm a shit-hot programmer. I don't need to care about what people feel." It turns out if you do, and you communicate nicely and respectfully with people, ...you get on a lot better in the world. It's a lot easier. Everything goes a lot more smoothly. (David Bruce)

In their work, Begel and Simon observe that "many of the problems they [new college graduates] have typically have a root cause in poor communication skills and social naïveté." [8] The experience David Bruce describes indicates that the year in industry helped him realise the importance of these skills before entering the workforce upon graduating from university.

# 7. DISCUSSION

## 7.1 Name & Frame

In reviewing the stories of participants who completed a year in industry, two aspects of their experience claimed our attention. One was the year in industry as a turning point, which marked a significant change in the narrator's life direction. The other was the notion of boundary objects bridging the academic and work environments.

As is often the case in qualitative work of this nature, these were not aspects we were specifically seeking at the outset of our work. Indeed, we noticed them in the interview transcripts before we fully understood them. Star vividly captures a researcher's sense of growing awareness that a particular phenomenon is important:

> "It is a little irritating feeling, kind of a pre-sneeze sensation – and it is also exciting. Learning to trust this message is the toughest lesson I have to teach my students – no less than myself." [56]

Having noticed, we then worked to name the phenomena; this in turn allowed us to locate each within a theoretical frame that provided additional explanatory power. We use them here to discuss graduateness and the year in industry.

## 7.2 Transitions & Turning Points

In their work, Enz and Talarico describe the difference between *transitions* and *turning points*. [16] The former involve changes in external circumstances; in the words of Brown et al., they "alter the fabric of daily life." [10] For example, relocating to a different city or even country would be considered a transition. In contrast, turning points describe a change in the trajectory of a person's life – they are the "turns in the road". [37] So while, for example, going to university marks a transition for everyone, it only becomes a turning point for some.

Turning points depend on a person's perception of change and the meaning they attribute to an event after it occurred. Thus, turning points only emerge in retrospective reflection. Elliot Mishler calls

this the "double arrow of time" which, he writes, "is an inherent and intractable feature of how we remember and continually restory our pasts, shifting the relative significance of different events for whom we have become…." [43] This means turning points are individually constructed and personally meaningful. They may not be reliably identifiable from the outside: identifying a turning point requires the narrator to explicitly establish causal connections between an event and a change in the direction of their life. (As a corollary, if the narrator does not view an event as contributing to a turning point in their life, we may never learn of its effect.)

Other studies have also used transitions as a lens into students' experiences. For instance, O'Shea explores transitions and turning points in the experiences of female first-generation students at university. [45] Palmer, O'Kane, and Owens focus on students' sense of "not belonging" as they transition from home to university. [46] And in a study with psychology students who completed a placement year, Auburn identified two *linguistic repertories*, one referring to the skills they had developed on placement, the other on how academic staff subsequently perceived and valued those skills. [6]

In this study, we coded the interviews for turning points using the two-part definition proposed by Enz and Talarico. [16] First, turning points require a change in a person's life direction. Second, they must refer to a specific episode, rather than an overall period of time.

> "Although perceived turning points may consist of several linked events within a temporally extended unit of time (e.g., college or a trip to another country), one must cite specific episodic experiences within the larger time frame in order to create causal links between the turning point and one's current life direction." [16]

Not everybody experienced the year in industry as a turning point, in fact, using this strict definition, we only found two turning points relating to the year in industry. We did not code several cases where participants described events as turning points, but did not specify a single episodic experience. Some participants for whom the year in industry was a transition identified limited immediate effects for themselves upon returning to their final year in university.

> Interviewer: Did the year in industry at Jalia influence the way, or change the way, you approached university when you came back?
>
> Respondent: A little. Not much. … it did influence in ways, but it's a fairly rigid final year, so not so much. (Nicholas Bradley)
>
> I think in terms of learning, the final year at university was really more of the same…. The final year of uni was the same again, really. (Melissa Bryan, 2006)

For participants for whom the year in industry was a turning point the effect was considerable. For instance, Nathan Baker spoke elaborately of the effect the year in industry had on him. He realized that the practices and theories he had learned at university provided the foundation for the work he was doing on large-scale software applications.

> And that is when I really started to enjoy my programming. Because at uni I was by no means one of the good programmers. Like you have got those few guys who have been writing code since they could type, and the first year projects for them are just a joke. But that [during the year in industry] is when I started to see myself as an actual programmer who could actually code in Java…. (Nathan Baker)

He also approached his final year differently:

> So I came back to uni and approached it in a very, very different way. Not only would I go to the lectures, I would sit at the front in the lectures. I would sit there making notes in the lectures. I would also go out and actually do that further reading that they recommended, each week whatever we did in the lectures regardless of the module, I would actually go and read the chapters and all the course books. (Nathan Baker)

Both of these excerpts reflect turning points: they each refer to a specific episode in time and describe a significant change in Nathan's life – towards viewing himself as a programmer and in engaging differently with his course at university. More than that, these turning points are connected to the transition of beginning and returning from his year in industry. Enz and Talarico found that these kinds of *transition-linked turning points* are often central to a person's life story. [16] Indeed, Nathan even used the term "turning point" to describe his experience.

> I think it is quite obvious that the big turnaround point is doing that placement year. (Nathan Baker)

## 7.3 Boundary Objects

We first noticed boundary objects in our interview with David Bruce in which he describes his experience at university before discussing his year in industry. With the exception of a brief reference earlier in the conversation, this is the first time he mentions his placement year in detail.

> … [at the university] there was a room … that was the Unix lab. You could get your Unix login and go and log in up there. [There was] this thing which was actually really cool. It was like a thin client thing where you just had this little box…. It would sit vertically next to the desk and there was a keyboard and a display, but it didn't really have any computing power in it itself. All of it was running on a big server somewhere.
>
> The university didn't issue smart cards, but Jalia did, and I worked at Jalia for a year as a Year in Industry. You had your ID badge which would let you into the building and so on. It had your picture on it, but you put it into the machine and it would bring up your session. You could move it around. … If you need to go and see somebody over the other side of the building, you can pull out your card and walk over there. (David Bruce)

The smart card here is the object that moves between university and year in industry with different, but related, meanings in the different situations.

> With your smart card, if you're going to London the next day, you pull it out ...and you get on the train in the morning and go up to London and put it in the machine in the London office and your session comes back. You can use all of that there. The smart cards would [all] work in the same way. When you got back

> from your year in industry I could do that, and it obviously wouldn't bring back your Jalia session but you could have it in the university. So you could suspend your session and put it back in. (David Bruce)

For David Bruce the talismanic "smart card" does not do the same work in both environments: on returning to university he is not able to use the smart card in the same way, yet it still carries meaning for him, although it is differently expressed in the academic environment. As a boundary object, it accompanies him in both environments and acts as an anchor for one kind of experience within another. His exposure to the infrastructure in the Unix Lab anticipates his experience at Jalia, where he receives his smart card. On his return, he brings his smart card with him: now it does not do the same work, but it echoes his experience on placement year.

Boundary objects do not have to be concrete "things". [57] While David Bruce's smart card is an artefact, we observed an abstract boundary object in the daily routine students establish during their year in industry.

> We worked in different companies, different environments. One of the guys worked in San Francisco in America. We all came back with the same idea. We want the structure so we can enjoy our weekends and we can enjoy the weeknights because we know we have dedicated time to do it in. (Jake Mason)

Upon returning to university, they retained the work patterns from their industrial placements.

> We sat and worked nine until five on our project every weekday. We took weekends off like you would in a real job. It was kind of not wanting to break that routine. (Jake Mason)

For Jake Mason the work ethic he and his team mates bring back from the year in industry is, as they recognise, out of place. After their year in industry, they do not return to student work patterns, but maintain the more highly structured timetable of the work environment.

> The next part would be about my final year, group projects, working in a team of people where we have all come back from placement. We have all got this kind of structure that we want to put in. We don't just want to be typical lazy students that will just sit down and work a bit, watch some telly and work a bit. (Jake Mason)

In this way, the time-management practices become a boundary object that the students carry between the two communities.

According to Star, there are three components to boundary objects: (1) Interpretive flexibility; (2) the structure of informatics and work process needs and arrangements; and (3) the dynamic between ill-structured and more tailored uses of the objects. [56]

For Star and Griesemer boundary objects mark the intersection of communities and mediate meaning between them. [57] In their example, animal skins act as a bridge between the world of fur trappers and the world of museum curators. By examining the object - the animal skin - the curators can be explicit about the things that they value in it (specific named species, undamaged skins). Looking at the skins with them, the curators' values are made apparent to the trappers, who usually work to different ends (monetary reward, ease of hunting, edibility).

Rather than boundary objects sitting between communities, in our work we see boundary objects carried between communities and carrying meaning with them. However, in both our constructions, boundary objects are central to the development of coherence across multiple social worlds. [57] In the stories we collected from graduates, these social worlds are the academic and professional workplace; the boundary objects integrate the experiences of one community within another.

# 8. CONCLUSION

In their longitudinal study of student transitions at university, Christie and colleagues write that "learning is not just about how students meet the requirements demanded of them at specific points in their academic career, but is embedded in the totality of their prior learning experiences." [12] Graduateness, then, as part of a person's life story, is constantly reconstructed and incorporates learning experiences from the past and present, and beliefs and expectations about the future. In this paper, we propose a narrative construction of graduateness that centres on students' individual experiences and the sense they make of them.

This sort of construction is significant because the value and purpose of an education is not just in the moment, but emerges over time. One of our study participants, Nathan Baker, noted:

> I think the thing that is quite common is that you are always, always learning. … Your vision of what you want to learn can only come from you. What you learned two years ago is probably going to mean nothing to you now but at the same time what you did learn serves... It is like layers isn't it? Where each thing is like a foundation layer for the next thing. And I guess that is something that I think if you look back at everything I have done, each thing provides the underlying layer for the next thing. (Nathan Baker)

In this paper, in the context of using a life story approach as a lens to examine graduateness, we focussed on students' experience of a year in industry. In doing so, two features emerged that illuminate both students' own conceptions of their education and the construction of graduateness more broadly. The first, turning points, indicate a major shift in a person's life. They feature prominently in the life story. Indeed, it would be hard to identify - or experience - turning points outside of storied narrative. The year in industry is a transition for everyone, but a turning point for some. The second feature, boundary objects, promote coherence across social worlds. [57] And as Habermas and Bluck established, coherence (with its four components) is central to the concept of the life story. [22] The year in industry exposes boundary objects as participants' carry meaning between the academic and professional workplace.

For students, the year in industry with its inherent change in external circumstances marks a stark contrast to the university experience. Yet, students return to university after their year in industry, carrying with them their work experiences and the sense they have made of them. This return to the academic world may be a significant quality of the year in industry. From the preliminary work we present here, the year in industry then seems to be a fertile location for the emergence of turning points and boundary objects. Having identified these constructs in this study, it may sensitise us (and other researchers) to see them in wider work to characterise graduateness in computing education.

## 9. ACKNOWLEDGEMENTS

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## 10. REFERENCES

[1] Adler, J.M. 2012. Living into the story: Agency and coherence in a longitudinal study of narrative identity development and mental health over the course of psychotherapy. *Journal of Personality and Social Psychology*. 102, 2 (2012), 367–389.

[2] Adler, J.M. et al. 2015. The Incremental Validity of Narrative Identity in Predicting Well-Being: A Review of the Field and Recommendations for the Future. *Personality and Social Psychology Review*. (May 2015), 1088868315585068.

[3] Adler, J.M. and McAdams, D.P. 2007. Time, Culture, and Stories of the Self. *Psychological Inquiry*. 18, 2 (Jun. 2007), 97–99.

[4] Amabile, T. and Kramer, S. 2011. *The Progress Principle: Using Small Wins to Ignite Joy, Engagement, and Creativity at Work*. Harvard Business Review Press.

[5] Amabile, T.M. and Kramer, S.J. 2011. Meeting the Challenges of a Person-Centric Work Psychology. *Industrial and Organizational Psychology*. 4, 1 (Mar. 2011), 116–121.

[6] Auburn, T. 2007. Identity and placement learning: student accounts of the transition back to university following a placement year. *Studies in Higher Education*. 32, 1 (Feb. 2007), 117–133.

[7] Bamberg, M. 2004. Form and Functions of "Slut Bashing" in Male Identity Constructions in 15-Year-Olds. *Human Development*. 47, 6 (2004), 331–353.

[8] Begel, A. and Simon, B. 2008. Novice Software Developers, All over Again. *Proceedings of the Fourth International Workshop on Computing Education Research* (New York, NY, USA, 2008), 3–14.

[9] Browne, J. 2010. *Securing a sustainable future for higher education: an independent review of higher education funding and student finance*. Department for Business, Innovation & Skills.

[10] Brown, N.R. et al. 2012. Historically defined autobiographical periods: their origins and implications. *Understanding Autobiographical Memory: Theories and Approaches*. D. Berntsen and D.C. Rubin, eds. Cambridge University Press. 160–180.

[11] Bruner, J. 1986. *Actual minds, possible worlds*. Harvard University Press.

[12] Christie, H. et al. 2016. "It all just clicked": a longitudinal perspective on transitions within university. *Studies in Higher Education*. 41, 3 (Mar. 2016), 478–490.

[13] Conway, M.A. et al. 2005. A Cross-Cultural Investigation of Autobiographical Memory On the Universality and Cultural Variation of the Reminiscence Bump. *Journal of Cross-Cultural Psychology*. 36, 6 (Nov. 2005), 739–749.

[14] Costa Jr, P.T. and McCrae, R.R. 1992. Four ways five factors are basic. *Personality and Individual Differences*. 13, 6 (Jun. 1992), 653–665.

[15] Deitrick, E. et al. 2015. Using Distributed Cognition Theory to Analyze Collaborative Computer Science Learning. *Proceedings of the Eleventh Annual International Conference on International Computing Education Research* (New York, NY, USA, 2015), 51–60.

[16] Enz, K.F. and Talarico, J.M. 2016. Forks in the Road: Memories of Turning Points and Transitions. *Applied Cognitive Psychology*. 30, 2 (Mar. 2016), 188–195.

[17] Fincher, S. et al. 2004. Cooperative education in information technology. *International Handbook for Cooperative Education*. R. Coll and C. Eames, eds. WACE. 111–123.

[18] Fincher, S. 2013. The Diarists' Audience. *Documents of Life Revisited: Narrative and Biographical Methodology for a 21st Century Critical Humanism*. P.L. Stanley, ed. Ashgate Publishing, Ltd. 77–92.

[19] Fincher, S. and Finlay, J. 2016. *Computing Graduate Employability: Sharing Practice*. Council of Professors and Heads of Computing.

[20] Glover, D. et al. 2002. Graduateness and Employability: student perceptions of the personal outcomes of university education. *Research in Post-Compulsory Education*. 7, 3 (Oct. 2002), 293–306.

[21] Guzdial, M. and Tew, A.E. 2006. Imagineering Inauthentic Legitimate Peripheral Participation: An Instructional Design Approach for Motivating Computing Education. *Proceedings of the Second International Workshop on Computing Education Research* (New York, NY, USA, 2006), 51–58.

[22] Habermas, T. and Bluck, S. 2000. Getting a life: The emergence of the life story in adolescence. *Psychological Bulletin*. 126, 5 (2000), 748–769.

[23] Hammack, P.L. 2008. Narrative and the Cultural Psychology of Identity. *Personality and Social Psychology Review*. 12, 3 (Aug. 2008), 222–247.

[24] Harris, R. 1996. Misleading talk of what is a graduate. *Times Higher Education*.

[25] Haveman, R. and Smeeding, T. 2006. The Role of Higher Education in Social Mobility. *Future of Children*. 16, 2 (Fall 2006), 125–150.

[26] Hewner, M. 2014. How CS Undergraduates Make Course Choices. *Proceedings of the Tenth Annual Conference on International Computing Education Research* (New York, NY, USA, 2014), 115–122.

[27] Holstein, J.A. and Gubrium, J.F. eds. 2011. *Varieties of Narrative Analysis*. SAGE Publications, Inc.

[28] Juzwik, M.M. 2006. Situating Narrative-Minded Research: A Commentary on Anna Sfard and Anna Prusak's "Telling Identities." *Educational Researcher*. 35, 9 (2006), 13–21.

[29] Klapproth, D.M. 2004. *Narrative as Social Practice: Anglo-Western and Australian Aboriginal Oral Traditions*. Walter de Gruyter.

[30] Labov, W. 1972. *Language in the Inner City: Studies in the Black English Vernacular*. University of Pennsylvania Press.

[31] Lewis, C.M. 2012. The Importance of Students' Attention to Program State: A Case Study of Debugging Behavior. *Proceedings of the Ninth Annual International Conference on International Computing Education Research* (New York, NY, USA, 2012), 127–134.

[32] Lister, R. et al. 2004. A Multi-national Study of Reading and Tracing Skills in Novice Programmers. *Working Group Reports from ITiCSE on Innovation and Technology in Computer Science Education* (New York, NY, USA, 2004), 119–150.

[33] Mattingly, C. 1998. *Healing Dramas and Clinical Plots: The Narrative Structure of Experience*. Cambridge University Press.

[34] McAdams, D.P. et al. 2006. Continuity and Change in the Life Story: A Longitudinal Study of Autobiographical Memories in Emerging Adulthood. *Journal of Personality*. 74, 5 (Oct. 2006), 1371–1400.

[35] McAdams, D.P. 2001. The psychology of life stories. *Review of General Psychology*. 5, 2 (2001), 100–122.

[36] McAdams, D.P. 1997. *The stories we live by: personal myths and the making of the self*. Guilford Press.

[37] McAdams, D.P. et al. 2001. *Turns in the Road: Narrative Studies of Lives in Transition*. American Psychological Association.

[38] McAdams, D.P. 1995. What Do We Know When We Know a Person? *Journal of Personality*. 63, 3 (Sep. 1995), 365–396.

[39] McAdams, D.P. et al. 2001. When Bad Things Turn Good and Good Things Turn Bad: Sequences of Redemption and Contamination in Life Narrative and their Relation to Psychosocial Adaptation in Midlife Adults and in Students. *Personality and Social Psychology Bulletin*. 27, 4 (Apr. 2001), 474–485.

[40] McCartney, R. and Sanders, K. 2015. School/Work: Development of Computing Students' Professional Identity at University. *Proceedings of the Eleventh Annual International Conference on International Computing Education Research* (New York, NY, USA, 2015), 151–159.

[41] Milburn, A. 2012. *University challenge: how higher education can advance social mobility*. Cabinet Office.

[42] Mishler, E.G. 1995. Models of narrative analysis: A typology. *Journal of Narrative & Life History*. 5, 2 (1995), 87–123.

[43] Mishler, E.G. 2006. Narrative and identity: the double arrow of time. *Discourse and Identity*. Cambridge University Press.

[44] Mishler, E.G. 2004. *Storylines: Craftartists' Narratives of Identity*. Harvard University Press.

[45] O'Shea, S. 2014. Transitions and turning points: exploring how first-in-family female students story their transition to university and student identity formation. *International Journal of Qualitative Studies in Education*. 27, 2 (Feb. 2014), 135–158.

[46] Palmer, M. et al. 2009. Betwixt spaces: student accounts of turning point experiences in the first-year transition. *Studies in Higher Education*. 34, 1 (Feb. 2009), 37–54.

[47] Pascarella, E.T. and Terenzini, P.T. 2005. *How College Affects Students: A Third Decade of Research*. Jossey-Bass.

[48] Plummer, K. 2001. *Documents of Life 2: An Invitation to A Critical Humanism*. SAGE Publications Ltd.

[49] Polkinghorne, D.E. 1995. Narrative configuration in qualitative analysis. *International Journal of Qualitative Studies in Education*. 8, 1 (Jan. 1995), 5–23.

[50] Pollen, A. 2014. Shared Ownership and Mutual Imaginaries: Researching Research in Mass Observation. *Sociological Research Online*. 19, 3 (Aug. 2014).

[51] Rebanks, J. 2015. *The Shepherd's Life: Modern Dispatches from an Ancient Landscape*. Flatiron Books.

[52] Sarbin, T.R. 1986. *Narrative Psychology: The Storied Nature of Human Conduct*. Praeger.

[53] Sfard, A. and Prusak, A. 2005. Telling Identities: In Search of an Analytic Tool for Investigating Learning as a Culturally Shaped Activity. *Educational Researcher*. 34, 4 (May 2005), 14–22.

[54] Snowden, D. 2011. Meaning & the content heresy. *Cognitive Edge*.

[55] Snowden, D. 2011. Naturalizing Sensemaking. *Informed by Knowledge: Expert Performance in Complex Situations*. K.L. Mosier and U.M. Fischer, eds. Psychology Press. 223–234.

[56] Star, S.L. 2010. This is Not a Boundary Object: Reflections on the Origin of a Concept. *Science, Technology & Human Values*. 35, 5 (Sep. 2010), 601–617.

[57] Star, S.L. and Griesemer, J.R. 1989. Institutional Ecology, `Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*. 19, 3 (Aug. 1989), 387–420.

[58] Steur, J.M. et al. 2012. Graduateness: an empirical examination of the formative function of university education. *Higher Education*. 64, 6 (May 2012), 861–874.

[59] Stevens, R. et al. 2008. Becoming an Engineer: Toward a Three Dimensional View of Engineering Learning. *Journal of Engineering Education*. 97, 3 (2008), 355–368.

[60] Urahn, S.K. et al. 2012. *Pursuing the American Dream: Economic Mobility Across Generations*. The Pew Charitable Trusts.

[61] Webb, B. 1938. *My Apprenticeship (Volume 2)*. Penguin.