Towards a Pattern Approach for Improving Enrollment and Retention of Female Students in Computer Science Education

CHRISTIAN KÖPPE, HAN University of Applied Sciences, Arnhem, the Netherlands
ANNE BARTILLA, Rotterdam University of Applied Sciences, Rotterdam, the Netherlands

Enrollment and retention of female students in computer science education remains very low compared to other disciplines, even though numerous efforts have been made to change the status quo. Society begins to recognize the importance of increasing the number of qualified women in information technology, but this has not yet lead to large-scale sufficient improvements when it comes to education. But education is one of the most important areas of human endeavor in need of change as it lays the foundation for a successful career in the IT field. However, there are reports on successful activities and there are research results which point to potential valuable strategies that institutions can apply.
In this paper we start to explore the possibilities of applying a pattern approach to describing successful strategies for improving enrollment and retention of female students in computer science education. We propose three patterns: APPLICABILITY HIGHLIGHTING, INCLUSIVE APPROACH, and INCLUSIVE REPRESENTATION.

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1. INTRODUCTION

Information technologies (IT) shape our daily lives and the economic growth depends on it. Computer Science—or more general: Computing— forms the basic academic discipline that lets these information technologies emerge. Forecasts are that the number of computing-related jobs will continue to grow over the next years (see e.g. [Ashcraft and Blithe 2009]). This field therefore offers good job opportunities for now and in the future. Even though the usage of IT in daily life seems to be equally distributed among males and females, the number of women employees in computing-related jobs is still low (even if growing). This uneven distribution of males and females in computing also still shapes the masculine image of this field, which seems to be one of the reasons why so few females take a computing career path. The fact that not many young women choose to study computer science (CS) or related disciplines makes this situation even worse. In the Netherlands for example on average 4% of computer science students (at bachelor level) are female [Dienst Uitvoering Onderwijs 2014].

Author's address: christian.koppe@han.nl, a.bartilla@hr.nl

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So addressing low enrollment and retention of female students in CS education addresses two issues: (1) it leads in long terms to a valuable diversity in computing and (2) it leads to a needed higher number of potential employees in computing-related jobs.

Numerous papers and books have been published describing research into the reasons for low enrollment and retention rates of women in computer science education (e.g. [Cohoon and Aspray 2006; Hill et al. 2009; Lagesen 2011; Sørensen et al. 2011; Sørensen 2011]). Suggestions for how to improve the situation are often given, but in many cases these are specific for institutions, academic levels, countries etc. They also differ in the way of describing the findings, which makes it difficult for other interested people to reuse this valuable knowledge and adapt it to their specific situations. What would be helpful is a consistent, shareable, and comprehensive way of documenting proven good practices, including all additional information required for successful application of these practices.

Patterns have been proven to be a valuable way of documenting this kind of knowledge. Architect Christopher Alexander [Alexander et al. 1977] and colleagues defined patterns as a formulae that “describes a problem which occurs over and over again, and then the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice". Patterns have since been described and applied in many different fields, including software design, organizational development, and also in education. Especially educational patterns span different levels of educational actions [Baumgartner 2011], ranging from small teacher-student interactions (like REMOTE HAND [Köppe and Schalken-Pinkster 2013]) up to curriculum development and didactical strategies of whole institutions (like NEW PEDAGOGY FOR NEW PARADIGMS [Pedagogical Patterns Editorial Board 2012]).

Using patterns to describe existing knowledge of female enrollment and retention practices offers additional advantages. Patterns as format are already well known to many CS educators, as they are part of the body of knowledge in software design and many other sub-disciplines of CS. Patterns offer a well-defined structure that highlights essential aspects of good practice. Patterns furthermore provide a common language that facilitates communication among educators, administrators, and professionals directly charged with recruitment and retention.

In this paper we intend to show the applicability of the pattern approach by proposing four proto-patterns[1] addressing three different aspects of the educational problem space. Table I gives an overview of these patterns. As we are in the very beginning with this work, we have not explored the relations between these patterns (and other possible patterns) yet. This will be part of future work, where we also include a relationship diagram.

Pattern Name	Problem Space	Summary	Target Audience
APPLICABILITY HIGHLIGHTING	Aimed at increasing the enrollment of female students by focusing on how to change the external representation (perception) of the study program	Don’t focus only on the technical aspects of computer science in the external representation, but also equivalently include aspects of applicability. Should be combined with INCLUSIVE REPRESENTATION.	Coordinators of study advertisement.
INCLUSIVE REPRESENTATION	Aimed at increasing the enrollment of female students by focusing on how to change the external representation (perception) of the study program.	When using pictures of students for advertising material, mix both male and female students and show both in a variety of contexts. Should be combined with APPLICABILITY HIGHLIGHTING.	Coordinators of study advertisement.
INCLUSIVE APPROACH	Applicable for the design of extra-curricular activities aimed at female students’ retention.	Activities that are focused on increasing students’ retention—by creating an “being-at-home" feeling, also known as “academic binding"—should address female students primarily as computer science students and not primarily as females.	Coordinators and organizers of extra-curricular activities.

Table I. : Proposed Patterns

[1] A proto-pattern is a proposal of a pattern which is assumed to work, but still misses empirical validation. See `http://c2.com/cgi/wiki?ProtoPattern`

In the next section we discuss how the patterns were mined and on what evidence they are based. Next, we describe the pattern format used, followed by the three patterns. We conclude the paper with suggestions for future work.

2. BACKGROUND

2.1 Pattern Mining Source

The proposed patterns are partly based on interviews taken with female computer science students at two Universities of Applied Sciences in the Netherlands. These interviews are part of a sociological research study published in [Bartilla 2014] that discusses the relevance of gender segregation related to the sociological concepts *doing gender* [West and Zimmerman 1987] and *habitus* [Bourdieu 1994], and to the sociological theory *masculinities* [Connell 2005] in the context of the low enrollment and retention of female students in CS education.

Doing gender means that we perform gender all the time during interaction, meaning that we want to convince the other person that we are female or male. Therefore people base their social actions on the knowledge of how male and female behavior should be so that others perceive them as masculine or feminine [West and Zimmerman 1987]. This knowledge is gained by education and parenting—the socialization.

The concept *habitus* means the socialization from a person, whereby the social structure from the society is connected to the individual behavior of men and women and is gender specific. *Habitus* is the lifestyle of a person, the usage of language, dressing, and taste and therefore the (self-)presentation of a person, the appearance, and also the body language.

The *habitus* of people causes *doing gender*, because in every social situation *habitus* is present. Both sexes can only exist in relation to the other, and in definition to each other. A masculine *habitus* produces a non-female *habitus* and the other way around.

The theory about *masculinities* considers masculinity not as one fixed entity, embedded in the characteristics of an individual. For Connell there are different forms of masculinity which are affected by the dynamic of the power-relations among men. The dynamic arises through the competition to achieve an ideal image of being a man in a particular context [Connell 2005].

By continuing to perform gender behavior in a valid way, notions of gender characteristics reproduce themselves again and again. Norms and expectations are passed along, which in consequence leads to allegedly typical male or female professions. This is one of the reasons for the low enrollment and retention of female students in CS education.

The findings of this sociological research in combination with findings in the literature on working approaches formed the base for the proposed patterns. This literature will be reviewed and discussed in the next section.

2.2 Literature overview

The typical computer scientist (still) is, among other characteristics as being white and young, generally male gendered, as indicated in interviews with students and staff of Dutch universities of applied science [Bartilla 2014]. This male image also correlates with other stereotypes assigned to masculinity, like being competitive, success-oriented, and a “lone wolf".

Klapwijk and Rommes showed that the masculine image of technology in general plays an important role in the study choice of young women [Klapwijk and Rommes 2009]. Computer Science as discipline is still seen as a very technical one, including a geeky and hostile culture [Alvarado and Judson 2014], and therefore also perceived as masculine. Additionally, the educational systems mainly focus on the functional and expert values, hereby failing to attract at least a part of the heterogeneous group of young women.

The reproduction from gender stereotypes is often triggered through the use of language and images. Many metaphors applied in computer science originate from the construction industry, like “building software" or “constructing a system". Such metaphors support a male gendered image of computer science [Boivie 2010]. Speaking of a “software architecture" links CS to the profession of architect, which is typically male gendered due to its mainly male occupation (see e.g. [Centraal Bureau voor de Statistiek 2014]). Programming and technique are put into a tradition of male gendered

knowledge and skills by associating it with masculinity and abstraction, leading to a symbolical power that contributes to a low percentage of females in CS [Boivie 2010].

Bennett, Brunner, and Honey argue that one should seek ways to validate both masculine and (so-called) feminine views of technology and not be trying to reinforce existing gender stereotypes or to look for a solution that is gender-neutral [Bennett et al. 1999].

Vivian A. Lageson [Lagesen 2011] shows that the percentage of female computer science students at the Norwegian University of Science and Technology (NTNU) at Trondheim increased in only one year from 6% to 30% because of a broad change of the perception of computer science in Norway. This perception change was, beside other reasons, also caused by a massive advertising campaign in TV and radio in cooperation with the inclusion project “Women and Computing Initiative" (WCI) at the NTNU.

Values that are of influence on the young womens’ choices are creativity, service, autonomy, and entrepeneurial. The interviews with Dutch female CS students [Bartilla 2014] also indicate that especially the possibility to express their creativity attracted them, even though this was not explicitly addressed in the institutions’ advertising activities. We therefore assume that addressing these values explicitly and beside the technical and functional aspects might increase enrollment of young women in computer science education.

Especially in the beginning of a CS study the differences regarding previous experience in programming or other disciplines of CS can be extensive. The students with more experience often dominate the class atmosphere, making it into a competition where the most masculine students seem to dominate the whole group.This competitive character is in many cases also embraced by educators, but especially in the first courses one of the reason for students’ dropping out. Young women, whose self confidence often already is lower than that of the male students (see e.g.[Cohoon and Aspray 2006]), often suffer from this male-dominated competition, together with other less-experienced students.

In a US-american study, Cohoon and Aspray show the correlation between entrance requirements to—and curriculum organization of—computer science as field of study and the low enrollment of female students [Cohoon and Aspray 2006]. This is especially relevant when experience with programming is obligatory and restricts the student population. As young women have proportionally less programming experience, due to a variety of social factors, they suffer most from such entrance requirements. And once enrolled, women find an overly strict curriculum an impediment to finding a more meaningful, and individual, engagement with the knowledge.

In recent interviews with Dutch female CS students [Bartilla 2014] they often expressed that they are less interested in activities that are addressing them as female students first and not mainly as CS students. Main reason is that this just increases their being special just because they are females. Lagesen reports in [Lagesen 2011] that an all-women lab, established as part of a larger initiative to recruit and retain more women in the computer science programme of the Norwegian University of Science and Technology (NTNU), was not used much by the female students. Main reason was that they often collaborated with men students and therefore would go to other labs. The women informants also stated that they experienced it as unfair towards the men.

2.3 Knowledge Aggregation into Patterns

Based on the previously discussed findings in research literature, we propose four proto-patterns as described in Table I. As mentioned before, these patterns were mainly mined from literature and based on research findings. This means that they are not proven in a sufficient number of instances (according to the *Rule of Three*[2]) and therefore we categorize them as proto-patterns. In some cases we found evidence in the literature that these patterns have (partly) been applied, if that is the case then we mention this in the pattern examples.

Furthermore, we mainly looked at European and North-American Studies with the intention to find the general aspects of the working solutions, the real patterns, independent of the cultural aspects of these specific environments. However,

[2]“A pattern can be called a pattern only if it has been applied to a real world solution at least three times.", see `http://c2.com/cgi/wiki?RuleOfThree`

we're aware that of course there are more cultural environments and we don't claim the applicability of the proposed patterns in these as well. Going this further step remains part of some future work.

In the next section we describe the patterns in detail. The pattern descriptions use an adapted version of the format used by Alexander et al. [Alexander et al. 1977]. Each pattern starts with a short description of the context, followed by three diamonds as a section separator. In the second part, the problem (in bold) and the forces, which shape the problem and explain why it is hard to solve, are described, followed by another three diamonds. The third part offers the solution (again in bold) and both positive and negative consequences of the pattern application which are part of the resulting context. We also provide advices for the implementation of the pattern and as last part an example of the pattern application. References to related patterns are made explicit by writing the names of these patterns in SMALL CAPS.

3. THE PATTERNS

3.1 Pattern: APPLICABILITY HIGHLIGHTING

Your institution is preparing advertising material for your computer science programs. This includes flyers, presentations and other kinds of material.

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Mainly focusing on the technical and functional aspects of computer science when communicating about it reproduces its masculine image and is likely to not attract many female students and in general is likely to exclude students who have no affinity with engineering and/or computer science.

Computer science comprises much more than technique, but people often become aware of these aspects when studying CS and not before. Because CS is often presented as being highly technical it is often perceived as being masculine, as in most cultures technique as such is mainly masculine gendered.

Values that are of influence on the young womens' choices are creativity, service, autonomy, and entrepreneurial. Interviews with (Dutch) female CS students also indicate that especially the possibility to express their creativity attracted them, even though this was not explicitly addressed in the institutions' advertising activities [Bartilla 2014].

The typical language used when representing CS often uses metaphors which originate in—and therefore are associated with—the building industry, like “building a program" or “the architecture of a system". The usage of such metaphors often connotes a male image of the discipline.

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Therefore: Develop and utilize a language for communicating about CS that includes and highlights the possible applications of CS. If women and men are meant and should be addressed, women and men must be named explicitly. Language socialized, creates reality, send signals and has an exemplary function. Communication is an interplay between transmitter and receiver. It works well, if recipients (the target audience) a message can be achieved. One should seek ways to validate both masculine and (so-called) feminine views of technology and not be trying to reinforce existing gender stereotypes or to look for a solution that is gender-neutral [Bennett et al. 1999]. Beside the technical aspects emphasize also values as creativity and entrepreneurship and show how CS relates to the application and use of technology in the world, hereby providing a more realistic picture of the discipline.

This language removes a part of the dual view of CS being connoted as mainly male or female, and is therefore more gender inclusive. For example represent technology not only for its own sake but in relation to their use. Illustrate the connection of men/ women and technology, technology as a solution of social problem, or technology and team work. It comes closer to how female students see the discipline themselves without removing the (important) technical aspects. Female CS students stated in interviews that they like CS because they learn "new languages there" and that they can “express their creativity by e.g. solving security problems related to cybercrime" [Bartilla 2014].

The solution does not suggest to replace the old descriptions in the advertising material, but to enhance them. Add for example showcases of real-life applications and how they fit into societal environments. Explain how creativity forms an essential part of computer science (innovative student projects can be used for this) and how good software can make a change. Present both aspects of computer science—techniques and applicability—as equally important.

One implementation related to this pattern, although not directly, is an activity at the Harvey Mudd College. They take young women who are about to choose their major to a Gracehopper Convention, which exposes the female students to a variety of non-technical aspects (beside meeting female role models too). The effect on the girls' choices was measurable and is, partly, also changed by the way computer science is presented as whole at these conventions through using a more inclusive language.

3.2 Pattern: INCLUSIVE REPRESENTATION

Your institution is preparing advertising material for your computer science programs and your goal is a diverse student population. You also want to use pictures of students for this material.

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The masculine image of computer science is reproduced if mainly—or only—pictures of male students are shown in the advertising material, especially if they're performing stereotypical male-gendered activities. The perception of computer science will be confirmed through the reproduction of the male gendered image. This will mainly further attract men as they can easily identify themselves with this image, while on the other hand women are likely to get a message of "you do not belong here". In this way the exclusion of women will continue

How we gender a discipline is—among other factors—dependent on the role models that we associate with this discipline. The typical computer scientist is often seen as a nerdy male (besides being young and white) and many pictures of typical computer scientists show males.

However, if female students are shown then sometimes their being female is emphasized, e.g. by using stereotypical colors like pink in the advertisements or by showing them in an obviously non-technical environment. This often happens unconsciously or even with good intentions, but also is counter-productive as it reproduces the segregation into male and female students.

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Therefore: Mix pictures also in videos, on web-pages etc.of male and female students. Show them both equally while representing different aspects of computer science, hereby creating inclusive representations instead of stereotypical ones.

It is not only that females are underrepresented in computing-related jobs, it is also that this picture is even made stronger by not showing the present ones. There's therefore a need to not only increase diversity, but also to increase visibility of the current diversity [Friedman 2014].

This means that pictures of female students should also be included in the advertising material. Include them in a way that shows both male and female students equally, doing a variety of computer science activities. It is important to avoid stereotypical representations or showing female and male students in a stereotypical way. For example, avoid using only male students for showing coding or only female students for showing collaborative or creative activities.

Be careful to use pictures which built up on according to this deficit model of computer science as too technical. In this approach women will be a complement to male students because of their communication skills and being people oriented. Ones can be counter-productive, as also can be seen in the results of the advertisement campaign of the NTNU for the Women and Computing Inititiative (WCI) [Lagesen 2011]. The main idea of the advertising campaign, as part of the whole WCI, was to converse stereotypes and deficits by redefining computer science as a feminine and non-technical discipline. According to the interviews taken later the (female) students "did not appreciate the gender essentialist messages; in general these were ignored" [Lagesen 2011]. Because female students want to be valued of their individual and professional qualities.

This pattern has been deducted from research findings only which mainly describe approaches with less or no success. We therefore cannot describe a known example here. Ideas of the concrete application would be to e.g. show a female student behind a screen full of source code or showing a group of male and female students in a lively discussion.

3.3 Pattern: INCLUSIVE APPROACH

You want to set up extra-curricular activities or initiatives that help to increase the feeling in female students of “being at home" at your institution.

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It often increases the unwanted feeling in female CS students of being handled different from the rest of the students if the activities, even with good intentions, address them mainly as female students and not as CS students.

Having activities that explicitly address females with the goal of creating a kind of “being at home" feeling is good, as this feeling isn't likely to evolve in such a male-dominated environment. But advertising such activities using a stereotypical and gendered way, e.g. using pink as main color for flyers or offering a baking workshop instead of an interesting CS-related activity, only intensifies the stereotypes. This also seems to explicitly exclude male students and therefore increases and reproduces the segregation of male and female students.

On the other hand, female students are very aware of that they are seen as different from the majority of male CS students—the ‘in/visibility paradox’ where women are simultaneously visible as women and invisible as (CS) engineers [Lagesen 2011]. Always being seen and treated as someone special—e.g. by having special activities aimed at female students—only increases this feeling, while they actually just want to be someone who studies computer science.

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Therefore: design extra-curricular activities that are inclusive and fit the needs of both female and male students. Address the female students mainly based on their interests and not by their being female.

Female students often need to position themselves in the male dominated CS student population. They don't want to be treated special just because they're girls, so they often use the strategy of trying to avoid being to “girly". That is one the reasons why they often dislike activities that explicitly address them mainly as females and not as CS students.

They also experience it as unfair for the men if activities or initiatives are exclusive for female students, as can be seen with the introduction of an all-women lab at the Norwegian University of Science and Technology (NTNU) within the “Women and Computing Initiative". According to the women informants of the study, none of them had used the lab much, mainly because they experienced it as unfair for the men (to not being able to have their own lab), but also because they did work together in groups with male students and these weren't allowed in the lab [Lagesen 2011].

It is important to note that this pattern is only about activities initiated by an institution. It is not relevant for activities that are self-organized by female students in a bottom-up approach. These activities, as e.g. networking groups for programming like RailsGirls[3] or PyLadies[4] are shown to be successful in many ways, but are nearly always initiated by the female participants themselves.

At the HAN University in the Netherlands, there is an event where all students of the computer science institute (together with students of communication) can present results of their student projects (without getting extra credits for it) and win prices in different categories. As these categories also include e.g. creativity, innovation, and entrepreneurship, this event also attracts female students.

[3] http://railsgirls.nl

[4] http://www.pyladies.com

4. CONCLUSION

In this paper we proposed three proto-patterns. These patterns were mined from various research findings and reports of good practices and working approaches.

We intend to continue working on further patterns, but also to validate the already described ones. The goal of this work is to come to a pattern language that holistically addresses the issue of underrepresentation of female students in computer science education and helps institutions to successfully tackle this issue.

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REFERENCES

ALEXANDER, C., ISHIKAWA, S., AND SILVERSTEIN, M. 1977. *A Pattern Language: Towns, Buildings, Construction*. Oxford University Press.

ALVARADO, C. AND JUDSON, E. 2014. Using targeted conferences to recruit women into computer science. *Communications of the ACM 57,* 3, 70–77.

ASHCRAFT, C. AND BLITHE, S. 2009. Women in IT: The facts. Tech. rep., National Center for Women and Information Technology (NCWIT).

BARTILLA, A. 2014. "Je mannetje staan": Kwalitatief onderzoek naar vrouwelijke informatica studenten in het hoger beroepsonderwijs. master thesis, University of Amsterdam, Amsterdam, NL.

BAUMGARTNER, P. 2011. *Taxonomie von Unterrichtsmethoden: Ein Plädoyer für didaktische Vielfalt*. Waxmann Verlag, Münster.

BENNETT, D., BRUNNER, C., AND HONEY, M. 1999. Gender and Technology: Designing for Diversity. Tech. rep., Education Development Center, New York. Nov.

BOIVIE, I. 2010. Women, Men and Programming: Knowledge, Metaphors and Masculinity. In *Gender Issues in Learning and Working with Information Technology: Social Constructs and Cultural Contexts*, S. Booth, S. Goodman, and G. Kirkup, Eds. Information Science Reference, Hershey, New York; USA, Chapter 1, 1–24.

BOURDIEU, P. 1994. Social Space and Symbolic Space. In *Contemporary Sociological Theory* 2de Ed., C. et al Calhoun, Ed. Blackwell Publishing Ltd, Oxford, Chapter 19, 267–276.

CENTRAAL BUREAU VOOR DE STATISTIEK. 2014. CBS StatLine - HBO en WO; afgestudeerden, studierichting, leeftijd.

COHOON, J. M. AND ASPRAY, W. 2006. A Critical Review of the Research on Women's participation in Post-secondary Computing Education. In *Women and Information Technology: Research on Underrepresentation*, J. M. Cohoon and W. Aspray, Eds. The MIT Press, Cambridge, Massachusetts, London, Chapter 5, 137–180.

CONNELL, R. W. 2005. *Masculinities* Second Edi Ed. Polity Press, Berkley, Los Angeles.

DIENST UITVOERING ONDERWIJS. 2014. Aantal hbo ingeschrevenen (binnen domein ho). Tech. rep., Dienst Uitvoering Onderwijs.

FRIEDMAN, A. 2014. Tech women are busy building their own networks.

HILL, C., CORBETT, C., AND ST. ROSE, A. 2009. Why So Few? Women in Science, Technology, Engineering, and Mathematics. Tech. rep., American Association of University Women, Washington, DC, USA. Nov.

KLAPWIJK, R. AND ROMMES, E. 2009. Career orientation of secondary school students (m/f) in the Netherlands. *International Journal of Technology and Design Education 19,* 4, 403–418.

KÖPPE, C. AND SCHALKEN-PINKSTER, J. 2013. Lecture Design Patterns: Improving Interactivity. In *Proceedings of the 20th Pattern Languages of Programs Conference, PLoP'13*. Monticello, Illinois, USA.

LAGESEN, V. A. 2011. Getting women in computer science. In *Technologies of Inclusion, Gender in the Information Society*, K. H. Sorensen, W. Faulkner, and E. Rommes, Eds. Tapir Academic Press, Trondheim, Norway, Chapter 7, 147–169.

PEDAGOGICAL PATTERNS EDITORIAL BOARD. 2012. *Pedagogical Patterns: Advice for Educators*. Joseph Bergin Software Tools, New York, NY, USA.

SØRENSEN, K. H. 2011. Changing perspectives on gender and technology: from exclusion to inclusion. In *Technologies of Inclusion, Gender in the Information Society*, K. H. Sørensen, W. Faulkner, and E. Rommes, Eds. Tapir Academic Press, Trondheim, Norway, Chapter 2, 41–61.

SØRENSEN, K. H., FAULKNER, W., AND ROMMES, E., Eds. 2011. *Technologies of Inclusion. Gender in the Information Society*. Tapir Academic Press, Trondheim, Norway.

WEST, C. AND ZIMMERMAN, D. H. 1987. Doing Gender. *Gender & Society 1,* 2, 125–151.