The SimSpay—Student Perceptions of a Low-Cost Build-It-Yourself Model for Novice Training of Surgical Skills in Canine Ovariohysterectomy

Rikke Langebæk ■ Nils Toft ■ Thomas Eriksen

ABSTRACT

Practical and ethical considerations have led to an increased use of artificial substitutes for live animals in veterinary surgical skills training. However, commercially produced models are expensive and homemade models often require full-time staff to produce enough models for training large groups of students. In the Department of Veterinary Clinical and Animal Sciences of the University of Copenhagen, a low-cost build-it-yourself model, the SimSpay, was developed for novice training of surgical skills in canine ovariohysterectomy. The model did not require the use of trained technical staff or costly, hard-to-source supplies. The SimSpay was developed and implemented in the clinical veterinary curriculum in 2013. In 2014, 54 students participated in a questionnaire study to investigate their perception of the usefulness of the SimSpay as a learning tool. On a five-point Likert-type scale, students were asked to rate their perceived levels of competence, confidence, and anatomic knowledge before and after SimSpay training. Results demonstrate a strongly significant ($p < .0001$) increase in all three areas after training on the SimSpay. By increasing students' perceived levels of competence, confidence, and anatomic knowledge, the low-fidelity SimSpay is a useful, low-cost learning tool for teaching ovariohysterectomy.

Key words: veterinary surgical education, low-fidelity simulator, self-efficacy, low-cost model, veterinary students, simulation

BACKGROUND

Neutering of dogs and cats is among the most commonly performed procedures in small animal practice.[1] Accordingly, canine and feline ovariectomy and ovariohysterectomy (OVH) are a central part of the veterinary surgical curriculum. In Danish veterinary education, fourth-year students perform the procedure in small animal teaching hospitals under close instructor supervision. However, to safely perform this procedure, students must have the opportunity to practice the surgical skills involved.

Traditionally, such training involves surgery labs with either live laboratory animals or cadavers. However, practical and ethical considerations have led to an increased use of artificial substitutes such as models and simulators for skills training in veterinary surgery.[2–5] This not only has ethical and practical benefits but also pedagogical advantages. Using models for teaching clinical skills supports the principles of educational theories by creating a stress-free learning environment where students can repeatedly practice and get feedback from educators.[6–9] Learning a complex task, whether it be the takeoff procedure of an airplane or a complicated surgical procedure, can be achieved either by training the entire procedure as a whole (whole-task or procedure-oriented method) or by breaking up the task into selected subtasks, which are subsequently practiced individually in a skills-oriented or deconstructed method.[4,8,10,11] Several authors describe how learning can be made more efficient by deconstructing a complex task.[9–13] Canine OVH is considered the most complicated of the neutering procedures,[14,15] and thus, by being a complex task, it seems well suited for training by the skills-oriented method. Accordingly, the surgical procedure is deconstructed into units or subtasks that are then taught separately. Subsequently, the tasks are put together and performed as a whole procedure.

In the Department of Veterinary Clinical and Animal Sciences of the University of Copenhagen, basic surgical skills are taught in a preclinical Surgical Skills Lab (SSL) in the first semester of the fourth year. Thus, students have experience with the individual skills that are involved in OVH when they move on to the second semester and the teaching hospital. However, a link between working with basic surgical skills in the SSL and working with live animal patients in the clinic seemed to be missing, and the novice surgery student appeared to the instructors as neither sufficiently competent nor confident to act safely in the operating theater. In novice surgical students, lack of confidence has been demonstrated to be

a major source of anxiety before live animal surgery,[16] and this can have a negative impact on learning.[17] Three key areas were identified for improvement: motor skills, key anatomic knowledge, and general surgical confidence. Accordingly, in 2013 it was decided to fill the gap by introducing an additional step: an OVH model. However, commercially produced models are expensive and homemade models often require trained staff to produce useful models in sufficient quantities when training large groups of students. Therefore, a low-cost build-it-yourself model (the SimSpay) was developed for focused novice training of the deconstructed surgical skills involved in OVH. The primary aim was to create a model that could enhance students' learning by supporting their surgical training technically, cognitively, and emotionally. Thus, the model should improve students' competence in the motor skills involved in OVH, improve their understanding of the anatomic structures involved, and increase their confidence in performing the surgery. A secondary aim was that the model should not require the use of dedicated technical staff or high-cost specialized supplies.

This paper describes how to build and use the SimSpay model, and investigates students' perceived level of competence, confidence, and anatomic knowledge before and after training on the model.

MATERIALS AND METHODS

Model and Setting

The SimSpay was used on the first day of students' clinical rotation, the day before their first surgery on a live patient. Two veterinary surgeons supervised the SimSpay lab in which 12 students worked in pairs. Before coming to the workshop, students accessed our e-learning platform and watched narrated videos, one demonstrating the different steps in building the SimSpay (18 minutes) and one demonstrating how to perform the surgical procedure (OVH) on the model (12 minutes).[a] In the workshop, two hours were available for completion of the entire assignment (building, performing, and assessing). Students were provided with a range of everyday materials, each of them simulating a selected anatomic structure central to the procedure (Table 1). The approximate cost of building one SimSpay was US$5/€4.

Table 1: Materials used for building the SimSpay model and the corresponding anatomic structure

Material	Anatomic structure
Disposable instrument tray/food container	Abdominal cavity
2 × long modeling balloons	Cervix, uterus
2 × short tube balloons	Peritoneal lining
2 × disposable wash sponge	Infundibulum
1 × red rubber band	Uterine vessels
2 × ½ red rubber band	Ovarian vessels
2 × brown rubber band (A)	Suspensory ligament
1 × brown rubber band (B)	Ureters
3 × disposable examination glove	Urinary bladder/omentum
1 × disposable kitchen cloth	Abdominal fascia

In addition, students were provided with adhesive tape, a pair of scissors, an office stapler, large paper clips, and a manual. Furthermore, it described and illustrated the step-by-step construction of the SimSpay. It described the eight central subtasks of the procedure as determined by the department's veterinary surgeons.

After building the SimSpay, students were evaluated while performing the OVH and completing the eight subtasks:

1. Incision of abdominal fascia
2. Fixation of ovary
3. Incision of suspensory ligament
4. Ligation of ovarian vessels
5. Incision of round ligament
6. Transfixed ligation of uterine vessels
7. Simple ligature of uterine body
8. Transection of uterus

Instructors evaluated the individual pairs of students by discussing and assessing each subtask during and after completion of the procedure. Even though the assessment form was structured, and took the form of an objectively structured assessment of technical skills (OSATS), it functioned as a formative assessment as well, providing students with feedback during their performance.

Subjects

The study group consisted of 81 (73 female, 8 male) fourth-year veterinary students participating in the course Small Animal Clinical Practice (spring semester, 2014). Students were invited to voluntarily participate in the study and fill in the questionnaire. Before initiating the study, the grading and the wording of the questionnaire were tested in a pilot study consisting of 10 students from the study population. All students provided informed consent for participation in the study, and confidentiality and anonymity was ensured for all participants. Approval for this study was given by the Ethical, Administrative, and Educative Boards of the Department of Veterinary Clinical and Animal Sciences, Faculty of Health Sciences, University of Copenhagen.

Questionnaire

A questionnaire was developed to survey students' perceived levels of competence, self-confidence, and anatomic knowledge. The study group filled in a questionnaire just before building the model, and two hours later, after training on the SimSpay, they filled in an identical questionnaire (Table 2). Grading of levels was done by using a five-point Likert-type scale.

Statistical Analysis

The Likert-type scores of competence, self-confidence, and anatomic knowledge before and after the procedure were compared using a paired Wilcoxon rank sum test to test the hypothesis that the SimSpay increased these factors for the individual student.

Table 2: Questionnaire used for surveying students' perceived levels of competence, self-confidence, and anatomic knowledge

Question	Grading
Technically, how competent do you find yourself before performing an ovariohysterectomy (OVH) tomorrow? (1 = not at all competent; 2 = not competent; 3 = acceptable; 4 = competent; 5 = very competent)	1 2 3 4 5
Mentally, how confident do you feel about having to perform the surgery? (1 = not at all confident; 2 = not confident; 3 = acceptable; 4 = confident; 5 = very confident)	1 2 3 4 5
How good is your knowledge of the anatomic structures involved in the procedure? (1 = very bad; 2 = bad; 3 = acceptable; 4 = good; 5 = very good)	1 2 3 4 5

RESULTS

Out of 81 students, 54 (67%) completed the questionnaire, which showed the following levels of perceived competence (Figure 1), confidence (Figure 2), and anatomic knowledge (Figure 3) before and after the SimSpay training.

The figures illustrate that within all three areas (competence, confidence, and anatomic knowledge) the number of students rating themselves 4 or 5 increased after training on the SimSpay (*competent* and *very competent*: 5 before, 35 after; *confident* and *very confident*: 6 before, 36 after; *good* and *very good*: 15 before, 42 after), while the number of students rating themselves 1 or 2 decreased (*not at all competent* and *not competent*: 18 before, 0 after; *not at all confident* and *not confident*: 20 before, 1 after; *very bad* and *bad*: 3 before, 0 after). Using a paired Wilcoxon rank sum test to compare the Likert-type score before and after the SimSpay training gave strong statistical evidence ($p < .0001$) for the hypothesis that students increase their level of perceived competence ($p = 9.4e-10$), self-confidence ($p = 1.7e-9$), and anatomic knowledge ($p = 1.2e-8$).

All students in the study group managed to complete the task (building the SimSpay and performing the OVH) within the assigned 2-hour timeframe. Acquisition of materials for the SimSpay was easy and relatively inexpensive.

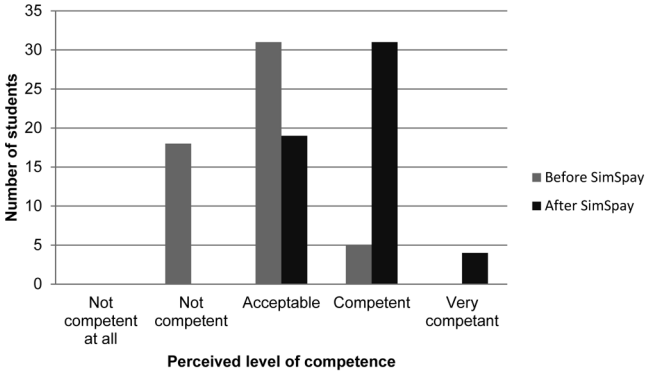

Figure 1: Students' perceived level of competence before and after SimSpay training ($n = 54$)

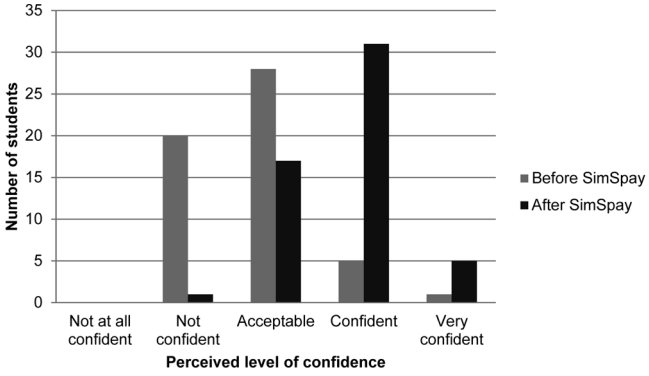

Figure 2: Students' perceived level of confidence before and after SimSpay training ($n = 54$)

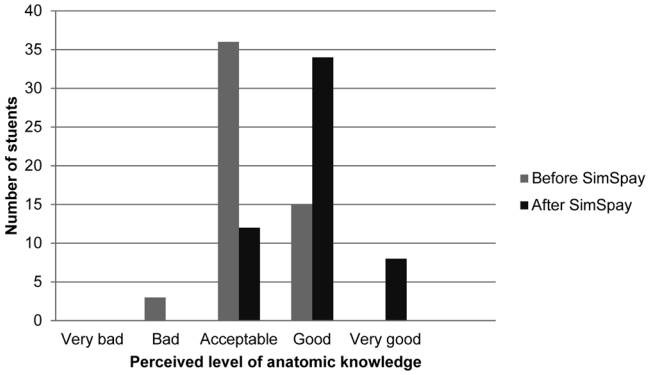

Figure 3: Students' perceived level of anatomic knowledge before and after SimSpay training ($n = 54$)

Figure 4: The SimSpay model

DISCUSSION

The SimSpay has been in use for more than a year, and students' spontaneous responses to this alternative training of an important core surgical procedure have been positive. Within a limited timeframe, students are able to build their own models, and they seem to appreciate the creative element associated with the building process. Thus, the model provides students with both procedural (visual, tactile, and dimensional) and emotional (fun, creative, low-stress environment) input, all of which has been shown to contribute to the usefulness of models and ultimately to successful training.[18]

The veterinary surgeons (seven alternating teachers, working in pairs of two) found it easy to assess the students when using the skills-oriented method provided in the OSATS formula, and the concept of the SimSpay lab allows them to spend time interacting with and assessing novice students in a low-stress environment. Solid evidence suggests that such immediate feedback as well as a positive, stress-free learning environment enhances learning.[17,19] Furthermore, the SimSpay is well suited for teaching by the skills-oriented or deconstructed method—a method that seems to improve learning of complex tasks.[9–13] The eight subtasks in our SimSpay lab were identified by the department's veterinary surgeons, but have not been subject to elaborate analysis. One could argue that a complex surgical procedure such as OVH could be deconstructed into even smaller components. It seemed logical, however, to deconstruct into subtasks that were identical to the basic surgical skills that students had already trained in the SSL.

Results from this study have demonstrated that training on the SimSpay significantly increases students' perceived levels of competence, confidence, and anatomic knowledge. Even though some research has demonstrated an association between confidence and post-training competence within surgical training,[20] others have found that high levels of confidence do not necessarily translate directly into high levels of surgical competence.[21,22] Likewise, students' perceived level of competence does not necessarily indicate an actual improvement in their competence at performing the procedure, and our findings therefore have no predictive value in performance assessment.

To evaluate the SimSpay as a tool to improve students' surgical performance in relation to OVH, thorough research into the competence levels before and after must be undertaken. However, to accomplish this, a control group of non-SimSpay trainees is needed. This has not been possible to establish in our current curriculum, but is in the planning for future research. However, the aim of the current study was not to determine the actual performance outcome of the students but rather to investigate the model as a learning tool.

In the educational setting, the simulated training session must be viewed holistically. Learning is not just a matter of passing on knowledge or skills, and therefore students' assessment of their technical skills (competence) should not be seen in isolation. In a learning situation, it is equally important that students be willing to perform the task: Do they have sufficient confidence to engage in the procedure? The perceived competence and confidence in a specific situation are part of the concept of self-efficacy.[23–25] Self-efficacy can be described as a situation-specific confidence[26]—in this case the belief that one is able to perform the specific deconstructed tasks included in the OVH. High levels of self-efficacy and confidence are associated with high intrinsic motivation and a willingness to engage in courses of action,[27–29] and in a learning situation such high levels are therefore desirable.

Even though the concepts of competence, confidence, and self-efficacy are closely connected, they do not necessarily correlate. A student can feel technically competent but still feel anxious about performing surgery (confidence)[30] and might end up not engaging in the task at all (low self-efficacy). In a study on emotions in veterinary surgical students, lack of confidence was the most common source of anxiety before surgery.[16] As high levels of anxiety have a negative impact on learning,[31–34] it is important for students to feel confident in the learning situation. However, being over-confident and not feeling the need to make an effort can also have a negative effect on learning and performance, so some amount of self-doubt may be useful.[20] In our study, it may therefore be interpreted as a positive finding that only a small percentage (9%) of students felt very confident even after training on the SimSpay.

If we focus on the learning situation instead of the outcome, it is possible to conclude that the SimSpay is a useful learning tool for training OVH because of its effect on students' perceived competence, confidence, and anatomic knowledge. With regard to actual improvement in performance (OSATS score), our findings are inconclusive. The question is which is more important in the long run: proving a high score in the OSATS, demonstrating that the student is able to perform (copy) a series of skills, or being able to provide an optimal learning situation that motivates students and ultimately enables them to use the learned skills in new situations and under novel circumstances?[35–37] Further research into this matter seems relevant now that more and more veterinary educational institutions implement skills labs and often use traditional assessment methods based on outcome measures.

Because of the build-it-yourself principle, it is possible to provide students with their own personal model at little cost and staff effort. Furthermore, the principle of using inexpensive materials that are relatively easy to obtain from supermarkets or hardware stores means that the method and model may be attractive to veterinary training institutions with limited financial or technical resources. In summary, the build-it-yourself SimSpay is a useful low-cost educational tool that can improve the perceived levels of competence, confidence, and anatomic knowledge of novice surgery students and be easily implemented in a veterinary curriculum.

NOTE

a The educational videos demonstrating the building of the SimSpay and performing an OVH on the model can be found on YouTube (http://youtu.be/DGk24utOIfo and http://youtu.be/y0DzB6u9beg).

REFERENCES

1 van Goethem B, Schaefers-Okkens A, Kirpensteijn J. Making a rational choice between ovariectomy and ovariohysterectomy in the dog: a discussion of the benefits of either technique. Vet Surg. 2006;35(2):136–43. Medline:16472293

2 Scalese RJ, Issenberg SB. Effective use of simulations for the teaching and acquisition of veterinary professional and clinical skills. J Vet Med Educ. 2005;32(4):461–7. http://dx.doi.org/10.3138/jvme.32.4.461. Medline:16421829

3 Baillie S. Utilisation of simulators in veterinary training. Cattle Pract. 2007;15(3):224–8.

4 Smeak DD. Teaching surgery to the veterinary novice: the Ohio State University experience. J Vet Med Educ. 2007;34(5):620–7. Medline:18326773

5 Greenfield CL, Johnson AL, Schaeffer DJ, et al. Comparison of surgical skills of veterinary students trained using models or live animals. J Am Vet Med Assoc. 1995;206(12):1840–5. Medline:7790294

6 Kneebone R, Baillie S. Contextualized simulation and procedural skills: a view from medical education. J Vet Med Educ. 2008;35(4):595–8. http://dx.doi.org/10.3138/jvme.35.4.595. Medline:19228914

7 Kneebone R, ApSimon D. Surgical skills training: simulation and multimedia combined. Med Educ. 2001;35(9):909–15. http://dx.doi.org/10.1046/j.1365-2923.2001.00997.x. Medline:11555230

8 Wang TS, Schwartz JL, Karimipour DJ, et al. An education theory-based method to teach a procedural skill. Arch Dermatol. 2004;140(11):1357–61. http://dx.doi.org/10.1001/archderm.140.11.1357. Medline:15545545

9 Read EK, Baillie S. Using cognitive task analysis to create a teaching protocol for bovine dystocia. J Vet Med Educ. 2013;40(4):397–402. http://dx.doi.org/10.3138/jvme.0213-033R. Medline:24077313

10 Jabbour N, Reihsen T, Sweet RM, et al. Psychomotor skills training in pediatric airway endoscopy simulation. Otolaryngol Head Neck Surg. 2011;145(1):43–50. http://dx.doi.org/10.1177/0194599811403379. Medline:21493270

11 Kishore TA, Beddingfield R, Holden T, et al. Task deconstruction facilitates acquisition of transurethral resection of prostate skills on a virtual reality trainer. J Endourol. 2009;23(4):665–8. http://dx.doi.org/10.1089/end.2008.0531. Medline:19335152

12 Perry RE. Laying the foundation of surgical skills for trainees (residents). ANZ J Surg. 2009;79(3):122–6. http://dx.doi.org/10.1111/j.1445-2197.2008.04827.x. Medline:19317775

13 Razavi SM, Karbakhsh M, Panah Khahi M, et al. Station-based deconstructed training model for teaching procedural skills to medical students: a quasi-experimental study. Adv Med Educ Pract. 2010;1(17):17–23. Medline:23745058

14 Griffon DJ, Cronin P, Kirby B, et al. Evaluation of a hemostasis model for teaching ovariohysterectomy in veterinary surgery. Vet Surg. 2000;29(4):309–16. http://dx.doi.org/10.1053/jvet.2000.7541. Medline:10917280

15 Bowlt KL, Murray JK, Herbert GL, et al. Evaluation of the expectations, learning and competencies of surgical skills by undergraduate veterinary students performing canine ovariohysterectomies. J Small Anim Pract. 2011;52(11):587–94. http://dx.doi.org/10.1111/j.1748-5827.2011.01120.x. Medline:22026742

16 Langebæk R, Eika B, Tanggaard L, et al. Emotions in veterinary surgical students: a qualitative study. J Vet Med Educ. 2012;39(4):312–21. http://dx.doi.org/10.3138/jvme.0611.068R1. Medline:23187024

17 Centre for Educational Research and Innovation. The impact of the environment on the learning brain. In: della Chiesa B, editor. Understanding the brain: the birth of a learning science. Paris, IN: OECD; 2007. p. 185–210.

18 Langebæk R, Berendt M, Pedersen LT, et al. Features that contribute to the usefulness of low-fidelity models for surgical skills training. Vet Rec. 2012;170(14):361. http://dx.doi.org/10.1136/vr.100181. Medline:22331503

19 Isen AM, Rosenzweig AS, Young MJ. The influence of positive affect on clinical problem solving. Med Decis Making. 1991;11(3):221–7. http://dx.doi.org/10.1177/0272989X9101100313. Medline:1881279

20 Clanton J, Gardner A, Cheung M, et al. The relationship between confidence and competence in the development of surgical skills. J Surg Educ. 2014;71(3):405–12. http://dx.doi.org/10.1016/j.jsurg.2013.08.009. Medline:24797858

21 Morgan PJ, Cleave-Hogg D. Comparison between medical students' experience, confidence and competence. Med Educ. 2002;36(6):534–9. http://dx.doi.org/10.1046/j.1365-2923.2002.01228.x. Medline:12047667

22 Leopold SS, Morgan HD, Kadel NJ, et al. Impact of educational intervention on confidence and competence in the performance of a simple surgical task. J Bone Joint Surg Am. 2005;87(5):1031–7. http://dx.doi.org/10.2106/JBJS.D.02434. Medline:15866966

23 Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977;84(2):191–215. http://dx.doi.org/10.1037/0033-295X.84.2.191. Medline:847061

24 Pajares F. Self-efficacy beliefs in academic settings. Rev Educ Res. 1996;66(4):543–78. http://dx.doi.org/10.3102/00346543066004543.

25 Schunk DH. Self-efficacy and academic motivation. Educ Psychol. 1991;26(3–4):207–31. http://dx.doi.org/10.1080/00461520.1991.9653133.

26 Feltz DL. Self-confidence and sports performance. Exerc Sport Sci Rev. 1988;16(1):423–57. Medline:3292264

27 Rea DW. Optimal motivation for talent development. J Educ Gift. 2000;23(2):187–216.

28 Bandura A. Self-efficacy. Wiley Online Library; 1994.

29 Lane J, Lane AM, Kyprianou A. Self-efficacy, self-esteem and their impact on academic performance. Soc Behav Pers. 2004;32(3):247–56. http://dx.doi.org/10.2224/sbp.2004.32.3.247.

30 Stewart J, O'Halloran C, Barton JR, et al. Clarifying the concepts of confidence and competence to produce appropriate self-evaluation measurement scales. Med Educ. 2000;34(11):903–9. http://dx.doi.org/10.1046/j.1365-2923.2000.00728.x. Medline:11107014

31 Gläser-Zikuda M, Fuß S. Impact of teacher competencies on student emotions: a multi-method approach. Educ Res. 2008;47(2):136–47.

32 Reschly AL, Huebner ES, Appleton JJ, et al. Engagement as flourishing: the contribution of positive emotions and coping to adolescents' engagement at school and with learning. Psychol Sch. 2008;45(5):419–31. http://dx.doi.org/10.1002/pits.20306.
33 Eysenck MW. Anxiety, learning, and memory: a reconceptualization. J Res Pers. 1979;13(4):363–85. http://dx.doi.org/10.1016/0092-6566(79)90001-1.
34 Sappington TE. Creating learning environments conducive to change: the role of fear/safety in the adult learning process. Innovative High Educ. 1984;9(1):19–29. http://dx.doi.org/10.1007/BF00903363.
35 Isen AM, Daubman KA, Nowicki GP. Positive affect facilitates creative problem solving. J Pers Soc Psychol. 1987;52(6):1122–31. http://dx.doi.org/10.1037/0022-3514.52.6.1122. Medline:3598858
36 Eraut M. Kinds of professional knowledge: modes of knowledge use and knowledge creation. In: Developing professional knowledge and competence. New York, IN: RoutledgeFalmer; 2004. p. 40–58.
37 Illeris K, Andersen V. Transfer i samspilsforløb [Transfer in interactive processes]. In: Læring i Arbejdslivet [Learning in working life]. Frederiksberg, IN: Roskilde Universitetsforlag; 2004. p. 165–79.

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