The Role of Narratives in the Co-construction of Community Identity in Physics

A critical examination of hero stories told at physics conferences and the implications for changing the gender balance in physics

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Abstract: The social character of a community is reflected in, and continually shaped by, its cultural mythology – the narrative stories that are told and re-told, and which perpetuate the community archetypes. The narratives most often repeated during professional physics conferences appear surprisingly similar in their underlying structure to traditional fairy tales of heroic journeys. The heroes – usually one of the icons of the physics community, or the narrator's thesis advisor - are almost always male. Women in traditional physics stories are portrayed most often as helpmates to the male physicists, while the few women physicists are portrayed as eccentric "others," tragic figures, almost foolishly heroic, who forsook traditional women's lives and persevered in their work in the face of prejudice. We suggest that the cultural mythology of physics may be closely tied with the archetypes of Western society defined by psychologist Karl Jung, which serve as organizing principles for behavior, and which operate at a subconscious level. We suggest that a close examination of the archetypes which are unconsciously perpetuated by the physics community, in part through the narratives which are told and re-told during community gatherings, may help understand why the social hierarchy in physics still seems to preferentially favor males, in spite of government efforts to recruit women into physics and engineering. We further suggest that perhaps a more equitable gender balance in the physics community will be achieved as a new feminine archetype emerges and finds her way into the physics lore.

Introduction:

Narratives are written or spoken texts, or symbolic performances, in which a transformation from an initial to a final state is recounted (Linde, 1993; Labov and Waletzky, 1997). The types of narratives that people tell may reveal a great deal about their perspectives, their expectations for the future, beliefs, and personal philosophy. Narratives may reflect cultural archetypes which shape community character, and when told during ritual gatherings, serve as a means of co-

constructing the identities of both the speaker and listeners as members of that community, and their places within the social hierarchy. Physics conferences in many ways resemble ritual community gatherings with ritualized performances: venerated elders (perhaps Nobel Laureates) as well as junior members present their research for community approval, exchange information and ideas, and socialize. At such gatherings, junior members of the community (graduate students and recent Ph.D.'s) learn what is expected of them if they wish to become full-fledged members. Conferences are powerful places where the work of identity management for the community can be accomplished.

At physics conferences, the narratives told are often reminiscent of the archetypal hero stories found in fairy tales, in which a hero sets out on a quest, overcomes obstacles, accomplishes his task, and is rewarded with a bride. The heroes most often portrayed are Nobel Laureates or other famous physics elders, or the narrator's thesis advisor, and almost always male. Women's roles in the majority of physics narratives resemble most closely the feminine archetypes in traditional western fairy tales: brides, handmaidens, or mothers. According to the famous Swiss psychologist Carl Jung, archetypes act as organizing principles for human behavior, operating at a subconscious and instinctual level, and deeply rooted in human psychology.

The persistent gender bias in the physics community, in spite of government efforts at science education reform which target girls, may be subtly maintained in part by the community psychology, which is constantly reinforced at a subconscious level through the perpetuation of community archetypes. This possibility has been suggested by anthropological studies which are normally outside the purview of mainstream of physics education research (Traweek, 1988; Wertheim, 1995). In this paper we borrow tools and expertise from sociolinguistics, anthropology, and psychology, which are outside the realm of traditional physics and physics education research, to hopefully bring a new awareness to the issues of gender equity in physics.

1. Defining the Physics Community

Before examining the role of narratives in constructing community identity in physics, we first define what we mean by *the physics community.* Physicists are found in virtually every country, so for the purpose of this study, we are concerned with American and European physics communities. We adopt the following definition of *community:*

A group of people who have a shared past, hope to have a shared future, have some means of acquiring new members, and have some means of recognizing and maintaining differences

between themselves and other communities. (Sharon Traweek, Beam times and Lifetimes*, 1988).*

Four domains of community life differentiate one community from another: *ecology*: the group's means of subsistence, the environment which supports it, and its tools for extracting a living from that environment; *social organization*: how the group structures itself, both formally and informally, maintains itself and resolves conflicts; *the developmental cycle*: how the group trains novices and transmits its knowledge and skills; and *cosmology*: how the group defines space, time, and the origin of the world (Traweek, 1988). Folklore is another means of characterizing a community, and physics is ripe with folklore in the form of stories, jokes, mnemonics, cartoons, iconic representations of famous physicists, and even superstitions.

2. The importance of narratives in maintaining community identity

Narratives have been shown to create a sense of self (Labov and Waletzky, 1997; Wortham, 2000; Schiffrin, 1996; Sawin, 1994), to create and maintain a sense of community (Johnstone, 1993; Bruner and Lucariello, 1989; Goodwin, 1990) and establish a sense of the self in relation to the community and the greater "cosmos" (Linde, 1993). Narratives can serve a homeostatic function by reinforcing a community's notions about the hierarchical (sometimes hegemonious) social structure, or they can serve a transformative, or possibly revolutionary, function by presenting allegorical examples in which a hierarchical social structure is overthrown. Nigel Eadly (2001) stated, *" Transforming the status quo becomes understood as a matter of challenging and changing discourses, encouraging people to tell different stories about themselves and others"* (p. 193).

Braid (2006) studied physicists' narratives as folklore forms which are seminal in the training of novices and managing identities in the physics community. He concluded that narratives in physics are used in three primary capacities: as a way of teaching novices how to "do good physics," as "cautionary tales" that allow listeners to learn from the mistakes of others, and as metatheoretical commentaries which highlight the relationships between theory, experiment, and human interaction (Braid, 2006). We suggest that physics folktales often follow the archetypal hero's epic, and thus in addition to teaching tales, form more or less a cultural mythology of physics. Toolan (2001) pointed out the significance of cultural mythology in maintaining universal archetypes which serve to create individual or group identity. Thus, we suggest that the narratives of physics folklore may be functioning so as to maintain the social hierarchy in the

physics community which preferentially favors males over females at the same time that these stories teach novices how to "do good physics."

The perception of the physicist-hero was described by anthropologist Sharon Traweek in her ethnography of particle physicists:
When humanity suddenly faces great danger, it is the scientist who alters the people's perception of the event, provides a solution, and thereby enables the threat to be controlled (Traweek,1988, p. 81).

We will discuss examples of narratives told at physics conferences which support this cultural perception.

3. Physics Conferences as Ritual Gatherings and Cultural Performances

A physics conference contains all the elements of a ritualized gathering, with cultural performances. There is a prescribed set of rules that are followed, in a particular order, to organize the conference and invite the performers and guests, who are ranked according to their seniority. The conference is usually held in a special location to which attendees must travel, and other ceremonial behaviors such as wearing business attire, set the conference apart from everyday life and mark it as a ritual gathering. During such gatherings the complete range of the community hierarchy may be present, from Nobel Laureates to graduate students, and thus conferences are one of the most effective means of transmitting community culture, and for constructing and managing identities within the social hierarchy. Thus, at a physics conference, the co-construction of community identity through spoken narratives is facilitated.

Several examples of narratives of physicist-heroes were recorded during the Future of Physics conference at the Kavli Institute of Theoretical Physics (KITP) at the University of California, Santa Barbara. (UCSB), in October of 2004. The full spectrum of community hierarchy was represented at this conference, including at least five Nobel Laureates, many prominent members of the physics community from all the major sub-disciplines, graduate students and postdoctoral scholars, and also visitors - non-physicist philanthropists who donate to the Institute.

We will analyze two of these narratives from two perspectives: First, how these stories conform to the structural elements of a narrative, and second, how these narratives represent community archetypes which are organizing principles of the social structure of the physics community.

Linde (1993) defined four structural features by which a narrative is recognized: the orientation, which may be preceded by an abstract; the narrative proper; an optional coda, with evaluative comments optionally appearing throughout the narrative. To demonstrate that the stories conform to the structure by which a narrative is recognized as a departure from the main thread of conversation, we will identify the line-by-line occurrence of these structural features. Propp (1928) identified universal elements of fairy tales which are related to Jung's cultural archetypes which both reflect and influence human psychology. We will identify the elements of the narrative which map directly or by inference onto the archetypal behaviors represented in fairy tales, according to a Proppian analysis.

4. The data: Critical examination of narratives told by "W" at the KITP Future of Physics Conference

We now examine two narratives told by "W", a Nobel Laureate, during his talk at the Future of Physics conference in October, 2004. In his talk, he enjoined the institute to continue the tradition of scientists playing a major role in the future of world politics. To illustrate his point, W told his version of three narratives from physics folklore as examples from history in which scientists played key roles in "saving" the world. The examples he chose were the development of the atomic bomb by the Manhattan Project during World War II, the invention of radar by his own thesis advisor, and the eradication of mad cow disease in England.

In our transcription we have used capitals to indicate vocal emphasis; vocalized pauses have been removed to give a smoother reading.
[The original talk can be heard at http://online.itp.ucsb.edu/online/kitp25/kohn/.]

4.1. W's Introduction:

1. I don't need to TELL this AUDience that,
2. that WHEN we justify basic SCIence it IS important to,
3. remind the public that ……
4. …the WORLD as we know it TODAY
5. really grew OUT of primarily BAsic science - ah research
6. but it is ALso important for us to REalize this, and to…
7. and to draw the CONsequences from this realization that
8. BAsic SCIence IS a very important HUman activity for its OWN sake. as well.
9. Now …it was mentioned today …that …

10. basic science ..has changed our world VIEW,
11. a number of times in -
12. … the CHANGE has been on an overWHELming scale
13. TAKE ah the Copernican Revolution for example
14. take the ideas of NEWton , of HEIsenberg
15. those, contributions have ah LEFT the world a different PLACE
16. NOT just in the sense of leading to useful PRACtices, applications, but in OTHER ways.

4.1.1. Discussion of W's Introduction:

In this introduction, W positions scientists as an elite group who are responsible for having shaped the world as we know it today. He effectively characterizes the duality between "us," which includes himself, the audience, and the greater community of scientists, and "the public" in his opening remark: *"I don't need to TELL this AUDience that WHEN we justify basic SCIence it IS important to remind the public that the WORLD as we know it TODAY really grew OUT of primarily BAsic science research."*

With his introduction, W is both defending science in the face of an imagined adversarial public, as well as defending the right for science to exist as an important human activity *for its own sake*. W's statement that the contributions of Copernicus, Newton, and Heisenberg have left the world a "different place" ascribe almost a creator-like function to these famous physicists, as if revolutions in western human thought have effectively altered not only our view of the universe, but the universe itself. Thus, in the introduction to his talk, even before W begins his narratives, we can see that he is characterizing scientists as being somewhat above and somewhat superior to the rest of humanity, characterized as "the public."

In this audience of physicists, it is not necessary to convince anyone of the value of basic research, however for anyone present from "the public," or for junior members of the community, such an introduction may serve to reinforce the view of physicists as heroes that was expressed by anthropologist Sharon Traweek:

In the popular cultures of rich countries physicists have become our guides to the galaxy, the purveyors of doom, our priests of all time and space, and the saviors of civilization (Traweek, 1998).

We now turn to W's first narrative: his version of the story of the Manhattan Project.

4.2. W's First Narrative: The Establishment of the Manhattan Project

17. ah…there HAVE been a FEW occasions
18. WHEN this – a few hisTOrical occasions
19. when there HAVE been, ah, treMENdous URgent threats
20. which threatened everybody
21. SCIentists, no more than others,
22. but SCIentists on those occasions have in FACT
23. played LEAding roles
24. in, FACing the challenge and in DEALing with it.
25. I'd like to give THREE examples.
26. The FIRST one was the THREAT that –
27. the first one goes back to the second world war
28. and it was the THREAT
29. of ah Nazi Germany acquiring …
30. NUclear weapons.
31. There was a RELatively small number of SCIentists
32. throughout the WORLD who were ABle to really ssess this,
33. to SOME extent.
34. In retrospect, we know that NObody assessed it quite correctly,
35. but they had SOME sense of how realistic or unrealistic this was.
36. and ONE of them, namely Szilard,
37. persuaded the most pacific man that one can imagine,
38. namely Albert EINstein
39. to write his famous LETter to President Roosevelt
40. which was authorized the establishment of the Manhattan Project.
41. On the Manhattan project was a theoretical physicist, namely Robert Oppenheimer,
42. You don't need to be reminded the FInal outcome of it.
43. It was eNOURmously tragic.
44. 200,000 people lost their lives in HiROshima and Nagasaki and
45. again with HINDsight we can say that –
46. certainly at least in the SECOND dropping of the bomb –
47. that loss was unnecessary.
48. The FIRST dropping of the bomb –

49. ok, is controVERsial, in my view that was ALso unnecessary.
50. But, there are good arguments on the other side.

4.2.1. Discussion of W's First Narrative of the Establishment of the Manhattan Project

After setting the stage in lines 1 – 16, W then focuses the audience's attention on the narrative that is about to begin in lines 17 – 25. Lines 26-41 form the narrative proper, with embedded evaluations. In line 41 he almost launches into another story by mentioning Robert Oppenheimer, but abruptly appears to change his mind, and in lines 42 – 50 he ends his narrative with a coda. The coda contains rather strong evaluative clauses which refer to the tragedy and unnecessary loss of lives. The message of this narrative is clear: the physicist-heroes saved the world from the threat of the Nazi totalitarian regimes, yet not without the cost of loss of life and perhaps a sense of shame. If we examine W's story of the establishment of the Manhattan Project in the light of Propp's (1928) elements of the canonical fairy tale, the embedded archetypes emerge. The primary elements which Propp found to be most common in fairy tales, extracted from his more extensive analysis, are:

1. Evil is recognized;
2. There is an imbalance in the world, and a desire to restore balance;
3. A hero emerges, and is recognized for his qualities;
4. The hero embarks on a journey;
5. The hero seeks the help of a wizard;
6. The king bestows favors on the hero to help him in his quest to overcome evil;
7. There is a battle;
8. The hero emerges victorious;
9. The hero takes a bride and ascends to the throne;
10. Order is restored, but not with the price of a loss of innocence.

In W's narrative of the Manhattan Project we can find almost a line-by-line correspondence with the elements of the canonical fairy tale:

1. Evil is recognized:

   there HAVE been a FEW occasions…

   a few hisTOrical occasions

   when there HAVE been treMENdous URgent threats …

2. There is imbalance in the world, and a restoration of balance is desired:

   the first one goes back to the second world war

and it was the THREAT

of Nazi Germany acquiring …

NUclear weapons.

3. The hero emerges and is recognized for his qualities:

There was a RELatively small number of SCIentists

throughout the WORLD who were ABle to really assess this,

to SOME extent….

and ah ONE of them, namely Szilard,

4. The hero goes on a journey:

persuaded the most pacific man that one can imagine,

5. The hero seeks the help of a wizard:

namely Albert EINstein

to write his famous LETter to President Roosevelt

6. The king bestows favors so that the evil can be overcome:

which authorized the establishment of the Manhattan Project.

7. There is a battle:

The battle is understood to be World War II

8. The hero emerges victorious:

Again, this is understood as common knowledge, as the allies won the war.

10. Order is restored, but not with the price of a loss of innocence.

On the Manhattan project was a theoretical physicist,

namely Robert Oppenheimer,

You don't need to be reminded the FInal outcome of it.

It was eNOURmously tragic.

200,000 people lost their lives in HiROshima and Nagasaki

(#9 has been intentionally omitted; the absence of the feminine will be discussed in Section 5.)

We begin to see how this narrative contains archetypal characters that reaffirm the human drama within the cosmos: the emergence of evil which threatens to overthrow the present balance and harmony of the cosmos; the emergence of one or more heroes who are both superhuman (archetypes of the perfect "Man") yet have human flaws; the hero's journey and the involvement of the wise man; the assistance of the king – the figure of power who stands between the material and spiritual worlds; and the final triumph over evil and transformation to a new order. There is almost a one-to-one correspondence between the archetypal characters and the real players in W's

story, with Leo Szilard as the hero, Albert Einstein as the wise man, President Roosevelt as the king, Hitler (understood) as evil incarnate, and the physicists of the Manhattan Project as the knights or advisors to the hero. The battle of good and evil is represented by World War II, and history tells us that good triumphed over evil and balance was restored – but not without a loss of innocence. W's brief mention of Oppenheimer without giving any his details is perhaps an allusion to the loss of innocence, in that this audience of physicists presumably knows the story of Oppenheimer's almost instantaneous rise to favor as the leader of the Manhattan Project and his subsequent fall from grace as an accused enemy of the State when he later opposed the continued development of nuclear weapons.

4.3 W's Second Narrative: Schwinger the Magician

W intended his second example of how scientists have averted disaster and saved the world to be the invention of radar by Julian Schwinger, W's own thesis advisor. W never did tell the story of how Schwinger invented radar; rather, he got side tracked by his own narrative of Schwinger's quirky behavior and apparently forgot to discuss radar at all.

51. Um…now my my OWN THEsis advisor, Julian SCHWINger
52. played a KEY role in another in anOTHER kind of CRASH program,
53. namely the development of RAdar -
54. or let us say more BROADly control of radiation on the MICROwave wavelength.
55. Now inciDENtally let me SAAy -
56. I don't know if you've HEARD all these STOries -
57. there are, for those of us who actually KNEW him, -
58. [we] have no problem at ALL believing them.
59. Julian had these ah - very unUsual WORking habits.
60. He worked, - ah, well, maybe …
61. maybe SOME of you don't find them so unusual.
62. He worked usually at night and so…
63. how he would function there as a member of a very FOcused group
64. was an interesting QUEstion. but it worked out very well.
65. Nobody ever SAW him but when people ran into some really TOUGH problem
66. they would put it on the BLACKboard
67. and in the MORning the problem would be SOLVED...
68. [AUDIENCE LAUGHS ~ 5 seconds]

69. and I'm not sure if there are any other Schwinger students here, but for US it is totally believable.

4.3.1. Discussion of W's Narrative of Schwinger the Magician:

Again, there is an orientation (lines 51 – 54), and a break from the original story in line 55 as W introduces the narrative which is about to begin. In lines 56 – 58 W again sets himself apart as a senior physicist, as one of the few people present to be old enough to have actually studied under Schwinger. W follows this set up with a request for trust from those who are perhaps too young to have known Schwinger, that for "those of us who knew him" the narrative is perfectly believable.

The Schwinger story alludes to a different archetype: rather than the hero's tale, this story refers to magic. This type of transformation can only take place in human society by means of the intervention of magical beings with superhuman powers, such as the elves who make shoes under cover of darkness. The key elements of a magic story are illustrated in this narrative as follows:

1. Magic happens under cover of darkness:
   He worked usually at night
2. Magic happens when humans cannot observe it, and without human intervention:
   Nobody ever SAW him
   but when people ran into some really TOUGH problem
   they would put it on the BLACKboard
   and in the MORning the problem would be SOLVED
3. Only the chosen ones are privy to the secrets of magic:
   and I'm not sure if there are any other Schwinger students here,
   but for US it is totally believable.

By establishing the fact that Schwinger was W's thesis advisor, W is not only reaffirming himself as a very senior member of the physics community chronologically, but further establishing himself as an extremely *elite* senior member of the physics community as a "Schwinger student." As such, W and other Schwinger students were privy to his magical powers.

4.4. The Missing Feminine Aspect

There is one important aspect of Propp's canonical fairytale which is missing from the both narratives: *the feminine*. In Propp's analysis of fairy tales, there is always the element of the

archetypal hero achieving wholeness by the spiritual union with a bride (feminine). The union of the hero and his bride mirrors the cosmic balance that is achieved when the polarities of the universe are operating harmoniously.

In some views, the ideal human is androgynous (Ivanova, 2003), thus the perfect union of hero and bride can be seen as a striving for this spiritual perfection which is neither male nor female, but simultaneously both. The ideal scientist does not need to seek a bride in order to become whole; it is his conquest and mastery of Nature, the archetypal female aspect of the cosmos, that completes the whole (Traweek, 1988). Examples of narratives in which physicists are represented as taking on female consorts, who may or may not have been their wives, are not usually repeated as part of the ritualized presentations at physics conferences, but are more frequently found in books.

In W's narrative, Schwinger shares some features with mythological characters of fairies and elves, who are often female, androgynous, or childlike and non-gendered. In this sense, Schwinger, the physicist with magical powers, embodies spiritual perfection as an androgynous figure, as described by Ivanova (2003).

4.5. Summary of the role of narratives in ritual gatherings of the physics community

The third narrative offered by W described a hero's journey similar to that expressed in the story of the Manhattan Project, in which a scientist in England, with all the financial resources that the Prime Minister could offer, eradicated a bovine disease which threatened the animal and human population. The details are not important; what is important to take away from this analysis are the following points:

1. Ritualized performances and community gatherings provide opportunities in which individual identities as members of a community are constructed and managed;

2. Narratives told at ceremonial gatherings such as physics conferences, at which the complete hierarchical spectrum from Nobel Laureates to graduate students is present can play important roles in managing community identity and individual self-concepts as members of the physics community;

3. Narratives in physics which tap into the community archetypes of physicist-as-hero and physicist-as-magician serve to reinforce the established hierarchy which preferentially represents men as the canonical physicists;

4. The feminine archetype is sometimes represented in physics narratives as Nature which is conquered, or is subsumed into the perfect physicist who is portrayed as a magical, perhaps androgynous, being.

We have presented only a few narratives which are representative of the hero story, however one has only to read popular physics books which recount the history of physics, to find a plethora of such narratives. Because narratives in physics folklore often follow the pattern of the canonical fairy tale as described by Propp (1928), they tap into the unconscious expression of archetypes in Western society described by Jung. Hence, we can begin to see how narratives told in ritualized performances of physics conferences, especially when told by senior members of the physics community such as Nobel Laureates, can be understood to perform a homeostatic function which acts to preserve the traditional hierarchy that favors males over females, that has persisted in the United States and Europe.

5. Narratives as potential means of community transformation, and implications for education

There is a paucity of heroine's narratives in physics folklore, as there is a corresponding dearth of well-known heroines in physics. When women in physics are portrayed, it is often in the canonical role of the handmaiden or bride of the hero-physicist in the traditional narratives. We reproduce one such well-known folk tale from the popular physics book, *The God Particle* by Nobel Laureate Leon Lederman:

5.1. Matter Waves and the Lady in the Villa

> A few months after Heisenberg completed his matrix formulation, Erwin Schrödinger decided he needed a holiday. It was about ten days before Christmas in the winter of 1925. Schrödinger was a competent but undistinguished professor of physics at the University of Zurich, and all college teachers deserve a Christmas holiday. But this was no ordinary vacation. Leaving his wife at home, Schrödinger booked a villa in the Swiss Alps for two and a half weeks, taking with him his notebooks, two pearls, and an old Viennese girlfriend. Schrödinger's self-appointed mission was to save the patched-up, creaky quantum theory of the time.
>
> The Viennese-born physicist placed a pearl in each ear to screen out any distracting noises. Then he placed the girlfriend in bed for inspiration. Schrödinger had his work cut out for him. He had to create a new theory and keep the lady happy. Fortunately he was up to the task. (Don't become a physicist unless you are prepared for such demands.) (Lederman, 1993, p. 167)

The message in this popular physics folk tale is clear: men are physicists and women are most effective when they are seen but not heard. The author's final admonition, intended to be humorous, has additional implications for archetypes in physics.

The heroine's tales of physics, such as do exist, tend to emphasize women's tragic stories, and the bravery of those women who persevered in spite of prejudice due to their sex. Women physicists are portrayed most often as "the other" – not the archetypal hero, not the bride of the hero, not the mother of the hero, and not the sorceress. Neither magic nor heroic intervention appears to work in their favor. One such well-known anecdote recounts how Emmy Noether, although admired and respected by prominent mathematicians and physicists of her time including David Hilbert, Felix Klein, and Albert Einstein, nevertheless was not allowed to be a member of the Philosophical Faculty at Göttingen because of her sex. David Hilbert is reported to have stormed out of a faculty meeting saying, *"I do not see that the sex of a candidate is an argument against her admission as Privatdocent. After all, we are a university not a bathing establishment "* (Byers, 1998). In the end, all he managed to accomplish for her was that the university permitted her to lecture without salary, under Hilbert's name.

Other famous women's stories include the exclusion of women from Nobel Prizes, even though they played seminal roles in the discoveries for which the Prize was given. Notable examples include Lise Meitner (1944 Chemistry Prize, awarded to Otto Hahn for the discovery of nuclear fission) and Chien Shiung Wu (1957 Physics Prize, awarded to T.D. Lee and Y.N. Yang for the discovery of parity violation). Even Marie Curie, the first woman to receive a Nobel Prize and the only person to receive a Nobel in both Physics (1903) and Chemistry (1911), is said to have been excluded from membership in the prestigious French Academy of Science because the academy did not accept women. Apparently, they would not make an exception - even for a woman with two Nobel Prizes.

6. Looking to the future

Our analysis suggests that the social hierarchy of the physics community may hope to evolve into a more equitable one as a new archetype emerges which includes women as heroines, equal to men. Almost a decade ago, Bucholtz (1999) recognized emergent identities among adolescent females in Northern California which she termed *nerd girls*. Among the identifying features of nerd girls described by Bucholtz are the value they place on individuality, intelligence, knowledge, egalitarianism, and cleverness, and their use of puns, humor, and sophisticated

vocabulary. She considered the nerd identity to be consciously chosen in defiance of the hegemonious identity of “cool girls” (ibid.) in mainstream Anglo-European youth culture.

A decade later, we observe women emerging in the top ranks of the physics community of the United States whose characteristics may be contiguous with the expressions of nerd girl identity discussed by Bucholtz. Such women have the potential to create new archetypes for women in physics. Currently, Lisa Randall, string theorist and Harvard professor, who has risen in popular status by virtue of her book *Warped Passages* in 2005, comes to mind as an example. As a female theoretical physicist who is talented as well as attractive, Randall and others like her may be in the process of helping to define a new archetype for women in physics. A brief personal story which Randall told during her presentation at the Future of Physics conference, which we reproduce here, is suggestive of this emergent identity for women in physics. In discussing the merits of her research in extra dimensions, Randall takes an abrupt personal turn which, in a few short sentences, establishes her importance in the physics community hierarchy with humor:

1. I think it's getting to the point where
2. even the fact that we haven't yet seen the HIGGS
3. is a little bit probleMAtic for supersymmetry
4. and um -
5. I'm very PLEASED that Frank reMINded me that I SHARE in the Nobel Prize
6. because, I actually BET him he would win the Nobel Prize before the Higgs was discovered.
7. < speaker laughs, audience laughs>
8. So I get ten dollars from the Nobel Prize
9. < audience applauds ~ 5-6 seconds while “Frank” takes out a ten dollar bill and hands it to the speaker>
10. …Ok, so um, back to extra dimensions …

(The reference to “Frank” in line 5 indicates Frank Wilczek who, with David Gross and David Politzer, all present at the conference, had recently been awarded the 2004 Nobel Prize in Physics for their discovery of asymptotic freedom in the theory of the strong nuclear interaction.)

Although not a narrative as we defined earlier, Randall’s personal story, inserted tangentially to the main body of her talk, can be understood as establishing herself as important and credible in the social order of the physics community. She is not a helpmate to the Nobel Laureates; rather, she challenged one of them in a friendly way and won. She is an accomplished physicist in her own right, and her efforts are recognized by the community; perhaps she is an example of an emergent female archetype in physics.

Toolan (2001) pointed out the significance of cultural mythology in maintaining universal archetypes which serve to co-create individual or group identity. Although physics itself is supposedly an objective discipline, we cannot ignore the role of the stories which are told and re-told, in texts and at conferences, in perpetuating effective archetypes in physics. Referring back to Traweek's definition of the four domains of community life, it is physics education - the developmental cycle which defines the way novices are trained and knowledge is transmitted – which offers one of the strongest potentials to develop a new community identity. We suggest that a more gender balanced physics community may naturally evolve as new female archetypes emerge, and that the most effective means of encouraging new female archetypes is through developing new paradigms for physics education. Recent proposed models for the introductory curriculum by Lederman and Hill (2004), van der Veen (2007), and others which start with symmetry and the contributions of Emmy Noether, which are seminal to all of physics, and the contemporary view of spacetime, offer potential for changing the narratives in physics, from which a new feminine archetype may emerge.

References:

1. Braid, D. (2006). Doing Good Physics: Narrative and Innovation in Research, Journal of Folklore Research, Vol. 43, No. 2, pp. 149-176.

2. Bruner, J., and Lucariello, J. (1989). Monologue as narrative recreation of the world. In I. Nelson (Ed.) Narratives from the Crib (PP. 73-97). MA: Harvard University Press.

3. Byers, N. (1998). E. Noether's discovery of the deep connection between symmetries and conservation laws. arXiv:physics/9807044 2(23), Sep 1998.

4. Ivanova, D.(2003). Fire Dancing Today: a Gift or Archetype Awakening? *in Bulgarsko Musikoznanie*, No. 1, 2003, p. 45-86

5. Johnstone, B. (1993). Community and Contest: Midwestern Men and Women Creating their Worlds in Conversational Storytelling, pp. 62-80, in Gender and Conversational Interaction, D. Tannen, Oxford University Press, Oxford, UK.

6. Keller, Evelyn Fox (1985) Reflections on Gender in Science, New Haven, Yale University Press.

7. Keller, Evelyn Fox, (2001). The Anomaly of a Woman in Physics, in Science Literacy for the Twenty-First Century, S. Marshall, J. Scheppler, M. Palmisano, eds., Prometheus Books, pp. 9-16.

8. Labov, W. and Waletzky, J. (1997). Narrative analysys: Oral versions of personal experience. Jounral of Narrative and Life History 7 (1-4), 3-38.

9. Lederman, L. M. (2003). Obstacles on the road to universal science literacy, in Marshall, Stephanie P., Judith A. Scheppler, and Michael Palmisano (2003) (Eds.) *Science Literacy for the Twenty-First Century*, New York: Prometheus Books, pp. 305-310.

10. Lederman, L. M. and Hill, C. T. (2004). Symmetry and the Beautiful Universe, Amherst: Prometheus Books.

11. Lederman, L. M. and Teresi, D. (1993). The God Particle. New York: Delta Books.

12. Linde, C. (1993). Life Stories: The Creation of Coherence. New York, Oxford: Oxford University Press.

13. Propp, V. (1928). Morphology of the folk tale. Translation ©1968, The American Folklore Society and Indiana University.

14. Sawin, P. (1994). Reconceptualizing "women's narrative" as contextualized narrative, In M. Bucholtz, A.C. Liang, and L.A. Sutton (Eds), Cultural performances: proceedings of the Third Berkeley Women and Language Conference, (pp. 631-641), CA: Berkeley Women and Language Group.

15. Schiffrin, D. (1996). Narrative as Self-Portrait: Sociolinguistic Constructions of Identity. Language in Society, 25, 167-203.

16. Tobias, Sheila, (2003). Women and Physics, Physics and Women, in Science Literacy for the Twenty-First Century, S. Marshall, J. Scheppler, M. Palmisano, eds., Prometheus Books, pp. 31-43

17. Toolan, M.J. (2001). Narrative: A critical linguistic introduction. London: Routledge.

18. Traweek, S. (1988). Beamtimes and Lifetimes, The World of High Energy Physicists, Harvard University Press, Cambridge, Mass. and London, England.

19. van der Veen, J. (2007). Symmetry and Aesthetics in Introductory Physics: An Experiment in Physics and Fine Arts Education, Ph.D. Dissertation, University of California, Santa Barbara.

20. Wertheim, M. (1996). Pythagoras' Trousers: God, Physics, and the Gender Wars, New York, London : W.W. Norton & Co.

21. Wortham, S. (2000). Interactional Positioning and Narrative Self-Construction. Narrative Inquiry, 10(1), 157-184.