9-1-2009

The Experience of Doing Science with an Artistic Spirit: A Hermeneutic Phenomenological Study

Krista Fogel  
The University of British Columbia, kristafogel@hotmail.com

Abstract
This paper focuses on the concept of extracognition. It reports a qualitative study that explored the perceived experiences of doing science with an artistic spirit through the voices of living scientists who also engage in the arts. The purpose was to understand how accomplished scientists who engage in the arts make sense out of their experience of doing science. Four highly able scientists with expertise in their field who also self-identified as actively engaged in the fine arts were given voice on their perceived experiences of doing science. Through hermeneutic phenomenological methodology using thematic analysis, four major themes emerged. This paper focuses on one theme, “Feeling Connected to Something More through the Arts.” Three sub-topics are explored in relation to extracognition: (a) intuition, (b) serendipity, and (c) spirituality. The role of the arts is emphasized in attaining such experiences. Educational implications, limitations and strengths, and future directions are discussed.
ISSN 1918-5227
Pages 111-127

Follow this and additional works at: https://ir.lib.uwo.ca/eei

Part of the Education Commons

Recommended Citation

This Article is brought to you by Scholarship@Western. It has been accepted for inclusion in Exceptionality Education International by an authorized administrator of Scholarship@Western. For more information, please contact jspecht@uwo.ca.
The Experience of Doing Science with an Artistic Spirit:  
A Hermeneutic Phenomenological Study

Krista Fogel  
The University of British Columbia

Abstract

This paper focuses on the concept of extracognition. It reports a qualitative study that explored the perceived experiences of doing science with an artistic spirit through the voices of living scientists who also engage in the arts. The purpose was to understand how accomplished scientists who engage in the arts make sense out of their experience of doing science. Four highly able scientists with expertise in their field who also self-identified as actively engaged in the fine arts were given voice on their perceived experiences of doing science. Through hermeneutic phenomenological methodology using thematic analysis, four major themes emerged. This paper focuses on one theme, “Feeling Connected to Something More through the Arts.” Three sub-topics are explored in relation to extracognition: (a) intuition, (b) serendipity, and (c) spirituality. The role of the arts is emphasized in attaining such experiences. Educational implications, limitations and strengths, and future directions are discussed.

The Reggio Emilia approach to childhood education sheds light on the benefits of learning in an artistically rich context. But how might this apply to adults? Just as Reggio Emilia exemplifies the importance of artistically rich contexts in childhood education, these contexts can also be important later in life for enriched learning and living. This paper focuses on a research study that investigated highly able scientists’ lived experiences of doing science as artists. In particular, there is a focus on extracognition, a new concept in representing and understanding giftedness (Shavinina & Ferrari, 2004).

Introduction

What is extracognition? Shavinina and Ferrari (2004) described it as the facets of intelligence that go beyond cognition. As such, it is a phenomenon of high ability that is not well understood. Extracognition, particularly in Nobel Laureates, includes the following aspects that
contribute to high ability, especially in the sciences: (a) specific intellectual feelings (e.g., feelings of direction, harmony, beauty, and style); (b) specific intellectual beliefs (e.g., belief in elevated standards of performance); (c) specific preferences and intellectual values (e.g., the "inevitable" choice of the field of endeavour by certain geniuses and internally developed standards of intellectual working); and (d) intuitive processes (Shavinina & Seeratan, 2004).

Shavinina and Seeratan’s (2004) research focused on extracognition in scientists. Their comprehensive study looked at autobiographical and biographical findings on scientific geniuses. Of particular interest are cited quotations by historically eminent scientists themselves. While these quotations readily reflect the extracognitive experience, a closer look at them reveals reference to the arts or artistic spirit, a term that Bohm (1998) described as sensitive perception, which is very important to the scientific spirit. For example, Max Planck, father of quantum theory, proposed that pioneering scientists “must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination” (as cited in Shavinina & Seeratan, 2004, p. 90).

Indeed, literature shows that throughout history, highly able scientists often engaged in the arts to a high degree (Potter, 2006; Root-Bernstein, 1987; Root-Bernstein & Root-Bernstein, 2004). In particular, Root-Bernstein found 400 instances in which famous scientists also considered artistic careers and were highly able in art as adults. Perhaps the most obvious historical figure who captures the interplay of science and art is Leonardo da Vinci (1452–1519). In his work, art and science supported one another harmoniously (Potter, 2006).

Based on the historical perspective of eminent scientists who also excelled in the arts and Shavinina and Seeratan’s (2004) research into past scientists’ experiences of extracognition, the current research addressed two questions: How do scientists today who engage in the arts interpret their experience of doing science? Are extracognitive experiences a part of their experience?

**Method**

A hermeneutic phenomenological approach was chosen as the research method for this qualitative study, with the intent of allowing sufficient openness to discover possible illustrations of extracognition and arts-related experiences. Hermeneutic phenomenology is based on phenomenological philosophy (Cohen, 2000). While phenomenology in general is concerned with the structure of an experience, hermeneutic phenomenology is interested in how people go about understanding their world. The structure of the phenomena is not important, but rather how the phenomena are interpreted (Cohen, 2000). Ricoeur’s (1981) theory of interpretation, from which hermeneutics stems, is connected tightly to the concept of *text*. Ricoeur emphasized that articulating the experience of being through language does not change it into something else, but makes the experience become itself. Hermeneutic phenomenology is, in this case, interested in the interpretation of the phenomena of doing science as an artist (Cohen, 2000) and bringing it to life by focussing on the lived experiences of people (Van Manen, 1990) through qualitative interviews, which are the most common way of producing qualitative data to illustrate first-person accounts of an experience (Polkinghorne, 2005). As such, hermeneutic phenomenology was chosen to get at the deeper and more personal meaning of doing science as an artist, giving scientific experts a chance to share their human side through interviews while allowing openness in order for the researcher to gain insight into new concepts like extracognition.

More specifically, hermeneutic phenomenology was appropriate for three reasons. First, it recognizes the inevitability of interpretation, meaning that findings do not claim to extend to
all scientists, but more so to similar scientists in similar contexts. Hein and Austin (2001) stated that hermeneutic phenomenology “involves a process of contextualization and amplification rather than of structural essentialization” (p. 9). The recognition that findings do not speak to all human experience is crucial for this study because the research question aims to amplify the experiences of a particular population (i.e., highly able scientists who engage in the arts) in the context of their time and place. Second, it recognizes the importance of language, whatever the form, and the interpretation that goes with that. “The hermeneutical–phenomenological approach to research investigates human experience as it becomes expressed in spontaneous productions of speech, of writing, or of art” (Von Eckartsberg, 1998, p. 49). As such, this approach fits the exploration of the perceived experiences of doing science by scientists who engage in the arts because it (a) encouraged the use of artifacts as vehicles for experience, such as artistic modes of scientific exploration, and (b) allowed experiences that are not easily visible to the participants to be discovered through deeper investigation of language and its amplification via the spontaneity of the approach. The hope, therefore, was to further understand the experience of doing science with an artistic spirit perhaps even beyond what the scientists are currently aware of, thus opening the floor to notions like extracognition. Finally, hermeneutic phenomenology is important in the context of education. While Van Manen (1990) focused on the importance of attending to the lived experiences of children for the sake of pedagogy, I propose that it is also important to attend to the lived experiences of educators.

Four participants (age 31–61) were recruited through word-of-mouth and networked introductions based on three criteria as described by Polkinghorne (2005): (a) experience with science at a high level (expertise) and self-perceived engagement with the arts, (b) willingness to describe that experience to a researcher, and (c) ability to sufficiently reflect on and verbally describe their experiences to an English-speaking researcher. Sample size was determined by intensity of anticipated contact needed to gather sufficient data on the phenomenon (Steeves, 2000).

As such, data collection consisted of three interviews with each participant, observations, and field notes. In compliance with a basic principle of hermeneutic phenomenology, that the driving force of human consciousness is to make sense out of one’s experiences (Kahn, 2000), three interviews gave ample room to ponder, reflect, share, and clarify the experience of doing science with an artistic spirit. To aid in this process, participants were given a list of possible questions to review before the first interview (Appendix A) and were asked to bring one or two of their own self-perceived artistic compositions to encourage conversation (permission was received to use photographs of these compositions for the dissemination of this research). When possible, the interviews took place in the primary setting of doing science for each participant. Conversation opened with a question like, “Tell me a bit about how you came to where you are today in terms of being a scientist and an artist. You can start perhaps at when you were a child.” Although a set of questions was used as a guideline, interviews were kept quite conversational, typical of hermeneutic phenomenological research (Kahn, 2000). As such, the first question dictated the flow of the remaining interview, and questions were varied to fit each participant (Rubin & Rubin, 1995). The first interview lasted between one and two hours. In the second interview, participants clarified and built on the researcher’s initial interpretations of their experience with doing science as artists, and the third interview consisted of verifying the researcher’s final interpretations of their unique stories. An aim of this approach to interviewing was to be open to possibilities of new meanings and understandings of giftedness rather than necessarily proving, disproving, verifying, or challenging existing conceptualizations.
Data were analyzed through thematic analysis (Braun & Clarke, 2006; Cohen, Kahn, & Steeves, 2000). Thematic analysis is a method used in qualitative research to identify, analyze, and report patterns or themes within data (Braun & Clarke, 2006). Detailed steps were taken (see Appendix B). In summary, individual thematic stories were constructed first and verified with participants for accuracy. This process involved identifying themes. Initial coding allowed many potential themes to be considered. Broader themes were then identified across the whole text, forming overarching themes that were related to the experience of doing science as an artist. The given themes were then reviewed and described, and a coherent story was constructed that spoke to the individual participant’s experience of doing science as an artist. Second, and most important, the merged thematic story was constructed as an amalgamation of all individual stories. This process involved taking the overarching themes from individual thematic stories and looking at them across all participants. Shared themes emerged and were combined and reworked to encompass quotations from all participants about the lived experience of doing science as an artist. Four major themes and several sub-themes emerged to create a final story that captured all participants’ experiences. Content of each theme was paraphrased to clarify its importance (Braun & Clarke, 2006). Finally the merged thematic story was produced and provided to the participants for verification.

For the purpose of this paper, I incorporated my own photography with the data in an attempt to model the fusion of art and science. Fusing the data with my own imagery invoked a deeper sense and interwoven understanding of participants’ experiences, allowing me to freely and enjoyably mix their voices in a beautiful way.

Results

Four main themes emerged from the data (Table 1) and are paraphrased in order to clarify their importance to the experience of doing science with an artistic spirit (Table 2). Note that the final theme Feeling Connected to Something More through the Arts is the focus of this paper as it suggests elements of extracognition in the experience of highly able scientists who engage in the arts. I defined this theme as “connecting or achieving a tie with something greater through the arts to make meaning in science.” “Something greater” is an elusive concept as it was described by participants as a greater power or at least something very difficult to explain.

Table 1

<table>
<thead>
<tr>
<th>Major Theme</th>
<th>Sub-Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risking Success in a Scientific Vocation</td>
<td></td>
</tr>
<tr>
<td>Feeling Healthy through the Arts</td>
<td>Satisfying an Innate Drive</td>
</tr>
<tr>
<td></td>
<td>Coping in a Stressful World</td>
</tr>
<tr>
<td>Gaining and Giving Different Perspectives through the Arts</td>
<td>Complementary Tools of Perception</td>
</tr>
<tr>
<td></td>
<td>Complementary Processes of Perception</td>
</tr>
<tr>
<td>Feeling Connected to Something More through the Arts</td>
<td></td>
</tr>
</tbody>
</table>

\[114\] Exceptionality Education International, 2009, Vol. 19, No. 3
## Table 2
### Summary of Major Themes and their Importance to the Experience of Doing Science as an Artist

<table>
<thead>
<tr>
<th>Major Theme</th>
<th>Paraphrase</th>
<th>Why It Is Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risking Success in a Scientific Vocation</td>
<td>This theme refers to the way in which science is approached as a vocation. It includes how scientists make sense of their vocations in a way that ignores the importance of money and reveres the importance of authentic self-propelled motives in their love for science. In this sense, “risking success” is a matter of putting success at risk as measured from the perspective of our current market-place paradigm.</td>
<td>This theme is important to the experience of doing science as an artist because it speaks to the struggle that scientists might have in speaking out authentically in their science vocation when a market-place paradigm is emphasized. Note, conclusions cannot be made on whether or not arts engagement has any causal impact. This is an observational link made between the dialogue engaged in and the fact that these participants engage in the arts.</td>
</tr>
<tr>
<td>Feeling Healthy through the Arts</td>
<td>This theme refers to various aspects of well-being, particularly what seems to be emotional well-being of scientists who balance their lives with the arts. It includes the experiences of satisfying an inner artistic drive and then using artistic engagement to cope in a stressful world.</td>
<td>This theme is important to the experience of doing science as an artist because it speaks to the experience of healthy lifestyle and self-care for scientists who are often in stressful or competitive environments.</td>
</tr>
<tr>
<td>Gaining and Giving Different Perspectives through the Arts</td>
<td>This theme refers to art and science as disciplines that aid one another in investigation and output through complementary perspectives. It considers art and science as complementary tools or complementary processes of perception in coming to one another’s understandings.</td>
<td>This theme is important to the experience of doing science as an artist because it speaks directly to the impact that engagement with the arts can have on one’s work as a scientist in terms of discovery and output and the excitement that goes with that.</td>
</tr>
<tr>
<td>Feeling Connected to Something More through the Arts</td>
<td>This theme refers to reaching a state that is beyond cognitive functioning. That state includes experiences of intuition, serendipity, or spirituality.</td>
<td>This theme is important to the experience of doing science as an artist because it illustrates the impact that the arts can have on one’s work as a scientist in light of reaching a state where creative ideas flow.</td>
</tr>
</tbody>
</table>

In the following, participants’ works of art are first shown as an introduction to their voices. Next, exemplary quotations and phrases from the participants are presented in an artistic and meditative way on my own photographic images. Intertwined are quotes by history’s great scientists who also found value in the arts, which are meant to mirror the quotes from this study’s contemporary scientists. The theme Feeling Connected to Something More through the Arts illustrates the general feeling of connecting to something more expressed by the participants. Subtopics illustrate intuition, which resonates with an aspect of extracognition (Shavinina & Ferrari, 2004); sensitivity to serendipitous events, which also resonates with extracognition; and spirituality, which was not recognized by Shavinina and Ferrari as an element of extracognition. Finally, a summary of the role of the arts in connecting to something more is presented.

---

1 Note that one participant did not identify as being spiritual or interpret any type of experience as a scientist or artist as being spiritual. Nevertheless, the other three gave strong accounts of spirituality, so it is therefore brought to attention.
Participants’ Work in the Arts

*Figure 1. Sculpture by David.*

![Sculpture by David](image)

David
Golgi Apparatus
Photo included with permission

*Figure 2. Science Fiction by Nina.*

![Science Fiction by Nina](image)

Nina
Darwin’s Paradox
Photo included with permission

*Figure 3. Painting by Kent.*

![Painting by Kent](image)

Kent
Title N/A
Photo included with permission

*Figure 4. Dance by Naori.*

![Dance by Naori](image)

Naori
The Seed
Photo included with permission
The Feeling of Being Connected to Something More

Scientists who engage in the arts seem to interpret a state in their experiences that is beyond cognitive functioning. This state is about connecting to something more or connecting to something unexplainable. Connect comes from the Indo-European root ned-, meaning “to tie” or “to bind” (ned-, 1997). This meaning alludes also to art, which stems from the Indo-European root ar-, meaning to “fit together” (ar-, 1997). The scientists’ words are a storied meditation about connecting or achieving a tie with something greater through the arts to make meaning in science.

“...the star above my head
energetic
whole being is singing
connected to the core of the Earth
useful for creativity
at one
connected...”

“The fairest thing we can experience is the mysterious. It is the fundamental emotion that stands at the cradle of true art and true science. Whoever does not know it and can no longer wonder, no longer feel amazement, is as good as dead, a snuffed out candle.”

-Albert Einstein

(as cited in Kaplan, 2001, pp. 72-74)
Intuition

an artist...
the intuitive part
good scientist
artist at heart
listening to instincts
in tune with yourself

wild ideas
immerse self
new connections
give brain time
sinks deep
then forget
switch gears
allow that to happen
do other stuff - artistic stuff

“Every now and then go away, have a little relaxation
for when you come back to your work
your judgement will be surer.”

-Leonardo da Vinci
(da Vinci, n.d./1938, p. 263)
Serendipity

run across something
right time for me to see
pick up
pop up
bring up
wow!

best things come
by accident
being open
being receptive
making space
take in what your eyes tell you
see
be still
let things come forward

“If I have made any valuable discoveries it has been owing more to patient attention than to any other talent.”

-Isaac Newton

(as cited in Cook, Deger, Gibson, 2007, p. 604)
Spirituality

it's more than me
connecting to something greater than yourself

science is a way to know God
tapping into a source
releasing into the environment around

higher purpose
sourcing something bigger
no thought
you're connected

Divine is speaking

“Whenever we proceed from the known into the unknown we may hope to understand, but we may have to learn at the same time a new meaning of the word 'understanding.'”

-Werner Heisenberg

(Heisenberg, 1962)
"After a certain high level of technical skill is achieved science and art tend to coalesce in plasticity, esthetics, and form. The greatest scientists are always artists as well."

-Albert Einstein

(Albert Einstein as cited in Kaplan, 2001, p. 37)
Discussion

The particular theme, *Feeling Connected to Something More through the Arts*, that is focussed on in this paper can be summarized by recognizing the use of the arts to connect to something more—something beyond cognition, opening doors to (a) intuition, (b) serendipity, and (c) spirituality to reach a higher form of creativity in science. While Shavinina and Ferrari (2004) described the first two concepts of intuition and serendipity as resonating with an extracognitive state, these participants contributed further by sharing that their experiences with the arts may help them to achieve these states. The application of this finding may extend to the role of the arts in education today.

Educational Implications

In addition to exploring the perceived experiences of doing science by scientists who engage in the arts, this study sought to develop knowledge for the field of scientific creativity as related to an artistic spirit, or sensitive perception (Bohm, 1998), and to enlighten educators on how to foster the holistic growth of students (Eisner, 2005). In particular, it recognizes the relevance of a shared spirit, blending the approaches of art and science in the school curriculum, particularly in light of fostering the development of highly able students. Shavinina and Seeratan (2004) argued that extracognition, as they have defined it, is “probably the highest level of the manifestation of the intellectual and creative resources of a personality and, therefore, an important criterion of intellectually creative giftedness” (p. 99). Shavinina and Seeratan proposed that the element of extracognition be taken into account in identifying gifted and talented children. This study suggests the importance in education of acknowledging sensitivity to unexplainable phenomena like intuition, sensitivity to serendipity, ability to feel beauty, and sensitivity to connecting to something more. Furthermore, Bohm touched on the idea that a scientific and artistic spirit share a commonality in that scientists want to understand not only the facts, but how they fit together, remembering that the word art stems from the Indo-European root *ar-*, meaning to “fit together” (*ar-*, 1997). As it follows, evidence from this study supports a focus on using artistic sensitivities like intuition and sensitivity to serendipitous events in the development of giftedness and talent for all students, but particularly those who show evidence of the ability and passion required for high-level achievement.

How can extracognition be fostered in our students? Findings from this study suggest that one way is through the arts. Certainly, Root-Bernstein and Root-Bernstein (2004) recognized that the devaluation of the arts in schools may have detrimental effects on creativity across disciplines. They noted that many eminent scientists have held the opinion that arts education may be necessary for fostering the highest forms of scientific creativity. In particular, extracognition in terms of intuition, encountering serendipitous discovery, and having feelings of beauty and connection might be fostered through a variety of experiences found in this study that speak to arts engagement. For example, allowing students to engage in art might foster intuitive leaps. In another way, developing “the artist within” might foster artistic processes that promote these sensitivities. Finally, arts engagement might invoke a connection to something more, allowing for highly creative ideas to flow. For example, one participant stated that she is sourcing something bigger when engaging in her artistic medium.
Limitations and Strengths

One limitation to this study was in recruitment. Because participants who engaged in both science at a high level as PhDs and in the arts were difficult to find, one participant was recruited who did not meet the requirement of PhD status. Having a small sample of four participants was a limitation as well. Although four participants was a sufficient number for this qualitative study considering that interviews were long and in depth, ideas and themes still did not fully reach saturation (Creswell, 1998). While the themes which emerged captured all participants’ experiences, responses within them were still diverse enough to be explored further, particularly the aspect of spirituality in Feeling Connected to Something More through the Arts. Perhaps through interviewing more participants, discarded data might be brought to life that speak more pertinently to already developed concepts in the literature such as extracognition.

Despite the limitations named, there were a number of strengths in this study. It offers the beginning of a journey into unearthing new concepts like extracognition (Shavinina & Ferrari, 2004). This exploratory research enabled insight into an unknown phenomenon and relevant and contemporary interpretations, with additional questions raised. In turn, data collection through three unstructured interviews proved an advantage, with each interview contributing new perspectives, insights, and rich offerings into the lived experiences of contemporary scientists who engage in the arts. Another strength was the diversity of participants, there being an equal number of female and male participants and those early in their career and later in their career, as well as a variety of areas of arts engagement and fields of science. Having diversity in such a small sample made it difficult at times to find saturation in themes, but strong themes emerged, with each participant contributing to all four thematic fields. Finally, this study gave participating scientists an opportunity to give voice to both a valued and at times hidden part of their lives: the inner artist.

Future Directions

Since this was an exploratory study in a new area, doing science with an artistic spirit, there are many implications for future research. First, while this study offers insights about doing science with an artistic spirit from the point of view of accomplished scientists in the work force, it would be informative to interview gifted children and adolescents about their experiences in doing science in order to understand various concepts of high ability that might tap into areas of extracognition (Shavinina & Ferrari, 2004). Certainly, Shavinina and Seeratan (2004) have explored similar extracognitive phenomena in gifted adolescents.

Second, future research needs to include more participants in order to gain a deeper understanding of the experience of doing science with an artistic spirit as an artist. It would be useful to have more saturation during data analysis in order to get a clearer understanding of concepts, like extracognition, which are difficult to grasp. Spirituality, in particular, as a possible component of extracognition, requires more participants for saturated results.

Third, while findings in this study argue for the use of arts in education on the backdrop of science, it is impossible to make any causal claims. Although first-person experience should not be discredited as a valid voice in arts advocacy, empirical evidence through quantitative studies might advocate more strongly for the arts in education.

Finally, a different method that enables scientists who are artists to communicate in their preferred mode of artistic expression may be useful. While hermeneutic phenomenology seeks
primarily to analyze text (Ricoeur, 1981), other modes of communicating their experiences of doing science as artists, such as through sculpture, painting, dance, and writing, may have resonated better with their preferred modes of personal expression. Arts-based research may be a good point of departure, and perhaps another form of analysis such as the case study method or biography (Creswell, 1998) would have let the participants’ unique and in-depth experiences stand on their own individually.

Conclusion

Extracognition as related to giftedness is a concept that has only recently gained attention (Shavinina & Ferrari, 2004). Participants’ voices in this study shed light on the potential role of the arts in conceptualizing extracognition in highly able scientists. In particular, the concept of an artistic spirit, or sensitive perception (Bohm, 1998), is highlighted as a contributor to scientific creativity of the highly able. This spirit or sensitivity appears to be encouraged through artistic practice. In particular, this study illustrates how the artistic spirit can encourage extracognitive sensitivities involved in (a) intuition and (b) serendipitous experiences already highlighted by Shavinina and Ferrari as extracognitive components in highly able scientists. It is less clear how the artistic spirit might encourage extracognitive sensitivities involved in spirituality and whether spirituality might even be considered an extracognitive component since one participant did not speak to this sub-topic nor is it a component of extracognition highlighted by Shavinina and Ferrari. Whatever the case, by giving accomplished scientists who engage in the arts a voice, we can at least begin to understand, through first-person accounts, the meaning of the arts in a science-driven society, and the implications of fitting together the two disparate worlds of science and art into gifted education while reconceptualizing what might be involved with states such as extracognition.

References


**Author’s Note**

Correspondence concerning this article should be addressed to Krista Fogel, 215 Cambridge Ave., Regina, SK S4N 0L6. Email: kristafogel@hotmail.com
Appendix A

Guideline for Interview Questions

1. Tell me how doing science is part of your life.
2. Tell me about how engaging with the arts is part of your life.
3. Can you describe a time when your experience in doing science had what you perceive as an artistic element to it? If so, what was that like? The process? The product? Feelings?
4. Can you describe a time when your experience in doing science had what you perceive as no artistic elements to it? What was that like?
5. Can you describe your experience of composing one of your works of art that you’ve brought? Try to describe it as vividly as possible. Do you feel that it or the process of it fostered any scientific investigations?
6. What do these experiences mean to you personally? What do they mean to you in terms of doing science? In terms of the scientific method?
7. Think back to a significant scientific investigation that gave you the most pleasure and satisfaction. What might you say made that success possible?
8. In your experience, do you feel it was important to literally engage in the arts?
9. What do you think about arts-integration with the sciences?

Appendix B

Steps Taken for Thematic Analysis

Analysis of Individual Thematic Stories

a. Read through the data several times in order to get a general sense of possible themes.
b. Engaged in data reduction (Cohen et al., 2000), where interviews one and two were combined, digressions eliminated, and pieces reorganized according to similar topics.
c. Initial coding of data where themes were numbered and put in brackets after each block of text, considering as many potential themes as possible, while keeping relevant surrounding data. Extracts of text were approached with the possibility of being not coded, coded once, or coded many times, giving opportunity to fit into future themes (Braun & Clarke, 2006).
d. Identified broader themes across the whole text by combining different codes to form an overarching theme that had to do with the experience of doing science as an artist.
e. Reviewed themes by weeding out, breaking down, adding, and refining already developed themes.
f. Defined themes and named them. This involved rearranging or deleting quotes or making new categories. Thematic formulations (Van Manen, 1990) further described what the theme was about and a coherent story was constructed that spoke to the individual participant’s experience of doing science as an artist.
g. Verified with participants the accuracy of the story and reworked themes as necessary to capture what was crucial to their unique experiences of doing science as an artist.

Analysis of Merged Thematic Story

a. Took individually finalized thematic stories, copied and pasted their overarching themes and thematic formulations into one document, and changed each participant’s words to unique fonts for organization.
b. Printed and cut up each quote from the individual thematic stories into the thematic formulations and wrote the main theme by it to keep track of where it came from.

c. Colour-coded the quotes of thematic formulations according to overarching themes that emerged.

d. Went through each coloured pile and wrote further thematic formulations that considered all participants. After sorting these new thematic formulations into piles, it was made clear which ones were most pertinent in speaking to all participants’ experiences.

e. Reworked these themes and sub-themes to encompass quotes from all participants.

f. Renamed themes to better capture the lived experience of what it is like to do science as an artist. If quotes did not form a coherent pattern under the themes, the theme was reworked, created anew, or discarded from analysis (Braun & Clarke, 2006).

g. Verified whether or not each participant indeed touched on each major theme.

h. Paraphrased the content of the data extracts under each theme, identifying their importance, and identifying why they are important (Braun & Clarke, 2006).

i. Produced the merged thematic story.

j. Verified the accuracy of the story with participants by checking if they felt it represented their individual experiences.