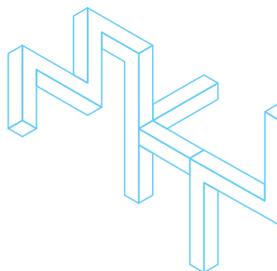# Knittstruments: Melodies of weaving

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Introduction

Observing knitting, we can see the workings of a special logic of assembly between the two knitting needles and the thread that follow certain protocols (von Busch, 2013). While knitting has been described as a rhythmic, slow, creating process, it seems less aimed to stimulate a knitter's creativity. The main focus of this research is not concerned with the creation of new knitting patterns or the combination of various techniques, but on the individual bodily rhythm and the body as a tool in use during the knitting process. By intervening in the traditional process of the craft practice with four interactive interfaces that transform knitting into sound, we investigate how the addition of auditory feedback, which makes the knitters aware of their bodily movement, affects their performance and enhances creativity.

In this paper, we first present the different ways in which knitting can creatively stimulate a craft practitioner and reflect on a knitter's embodied knowledge. By altering how the process of knitting is perceived, appealing to the embodied knowledge of the knitters, we believe that new kinds of creativity may be unlocked. We use the term knitting composition rather that knitting structure to account for musicality and leave room for improvisation in the definition that Tim Ingold provides for the latter: 'Knitted structure is an outcome of repeated, controlled movement in the process of spinning and looping' (2000). Needles, yarns and the knitters' expertise, influenced by sonic feedback, are the instruments used to complete a knitted composition.

Research Question

The research questions that this paper aims to answer could be formulated as: To what degree can a skilled practice, and the tacit knowledge that characterises it, be faithfully translated into a different expressive domain? Can such a domain translation creatively influence the activity being performed?

Literature Review

Creativity and Knitting

Creativity assumes diverse definitions depending on the field of expertise in which it is referred to. It exists in an infinite variety of forms and thus, formulating explanations of particular aspects of creativity seems highly convenient (Hargreaves et al., 2012, p.10). In this study we understand creativity, on the one hand, as the production of novelty through the

Abstract

Knitting is a slow, rhythmic crafting process that reflects on the knitter's skilled practice and embodied knowledge. Would it be possible to translate this knowledge into another language (that of music)? The key objectives of this paper are to analyse the role of the craftsman (knitter) and how it is influenced when the expressive domain of knitting is altered into music. To then investigate how an auditory feedback, which makes the knitters aware of their bodily movement, may affect their performance and trigger their creativity. The research is an ongoing process of multiple iterations based on action research and entails cycles of simultaneous data collection and analysis, which is based on the grounded theory methods of noting, coding and memoing. As a result, three different instruments (knittstruments) were assembled and tested in three different environments. Analysis of the data collected suggests substantial alterations in the knitters' performance due to audio feedback at both an individual and group level, and improvisation in the process of making. The contribution of this research is a further examination of knitting practices, focused on the relation between creativity and skill, building upon the knitter's embodied knowledge.

Keywords: *Crafting, knitting, sound interface, skill practices, creativity.*
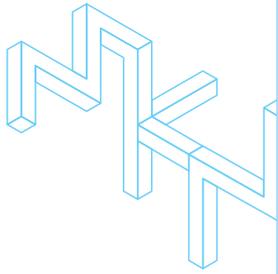
recombination of existing elements and, on the other, as a progress of growth, becoming and changing (Hallam & Ingold, 2007).

Knitting is loaded with tacit knowledge that speaks to us through our hands. It is both matter and process. If we observe knitting as the workings of a special logic of assembly between the two knitting needles and the thread that follow certain protocols (von Busch, 2013), then we read a knitted object as the creation of a knitting structure as if decoding a piece of text. Knitters follow specific knitting patterns and, it seems, a more methodical than creative activity. In that case, their creativity lies on the decision-making phase on colour variations, different qualities of yarns or the combination of different techniques. According to Ingold (Hallam & Ingold, 2007), it is 'based on the recombination of already extant elements'. Highly experienced knitters can also create their own patterns; a phenomena which is quite rare and based both on their skilled practice and their experimental character.

Knitting and its Rhythm
Knitting has a rhythm that is based both on the pattern that the knitter follows, and the way the body engages in the activity of creating such a pattern. The rhythmic, slow process of creating a knitting piece reflects the individuals' embodied knowledge and the degree of their skilled practice.

Experienced knitters hold the needles their own way, pulling the yarn in a specific manner, trying to minimise their movements in order to relax their bodies. They don´t seem to question how they knit, but simply rely on the various patterns, the techniques (knitting, crochet), the material properties and dimensions of the knitting needles according to the pattern, and the qualities and the colour of the yarns. Salustri and Rogers (2009) state that:

> *Once we have learned to do something in a certain way, we will tend to do that thing the same way forever, or until a better way presents itself (and sometimes, not even then). In this way, we will tend to not try other ways to do a thing because we have learned one way of doing it.*

Creating new patterns and experimenting with different knitting processes based on pattern generation enhance the knitter's creativity that is based on the pattern generation and creation. Murphy elaborates on the curiosity of knitting, how it is always open for new forms of stitches. 'Knitting is not merely an endless repetition of stitches and micro-patterns, but a rhythmic movement with different patterns of repetition, where one gets the result in action' (2002). According to Lefebvre, knitting is rhythm linked, on the one hand, to logical categories and mathematical calculations and, on the other, to the visceral and vital body (2004, p.14).

Apparently, every knitter has her individual rhythm and her unique way of knitting. In the flow of action (flow state) (Nakamura & Csikszentmihalyi, 2002) , the body itself becomes transparent, as do the tools attached to it (Ingold, 2010), which in phenomenological terms could be expressed as the tools are 'ready-at-hand' (Heidegger, 1977). Knitters do not need to think about their action, they are unaware of their bodily movements; rather they just act, as if it were an involuntary reflex. According to Sennett (2008) if we 'break the mold of fit-for-purpose' for the tool in use then we open new possibilities and the imagination of the craftsman.

In the following experimental settings we were focusing on bodily skills and their representation as a direct coupling of action and perception, and examine how the awareness of bodily movements can trigger creativity in a performative setting.

Methodology
In order to gain a better understanding of the relationship between craftsman, knitter, tool and skill, three different instruments (knittstruments) were set up for the specific circumstances, and tested in three different environments. We conducted qualitative research and employed a multi-method approach of action research (Stringer, 1999) and grounded theory (Glasser & Strauss, 2008). Both methodologies are iterative processes where theory and practice are interlinked. Diagnosis and action plans can be shaped bit by bit to make the most of growing understanding (Dick, 2007). We use the synergy of both to take advantage of the emphasis on participation from the action research approach and the data analysis principles from grounded theory. Each cycle of the action research methodology was recorded and grounded theory methods of noting, coding and memoing were used to analyse the data afterwards.

Interesting topics and key factors were identified and influenced the planning of the next iteration (Glasser & Strauss, 2008). In between the various iterations one of the researchers was an active member of the knitting clubs, building trust relationships between researchers and participants. Later, in the weekly meetings, knitters reflected on their practices during open-structured interviews.

Artefact Description
As in knitting, rhythm in music is a key element. In order to translate the knitter's expertise from the domain of material craftsmanship to that of sound, existing instruments were directly adapted to the particularities that characterise the choreographic nature of the activity of knitting. A drumming metal hi-hat, a directional microphone and a theremin were located in direct contact, right in front (2-5 cm) and 40 cm, respectively, from the needles. The sound output from each source would then be processed by a computer, either synthesising new sounds based on the knitting exercise, or influencing the output of the rest of the knittstruments performing at the same time (Image 1).
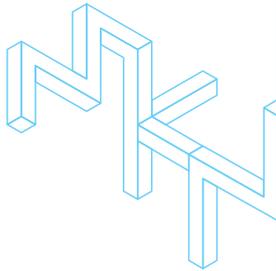
Image 1

Image 2

Image 3

Task

The main task was to make knitters aware of their bodily movements, by transforming knitting into sound. Musical instruments were the mediators of this transformation. Knitters had to compose music through their crafting practice with the help of musical instruments and digital technologies.

Data Analysis

Qualitative Analysis of Bodily Behaviour

From the first experiment the theremin proved to be a valuable bridge in translating every movement into sound, inviting the knitters to change their knitting routines. The instrument tracked every bodily movement (pulling the yarn, lifting the thread, moving the needles) and transformed it into sound (Image 4).

Video motion analysis software was used to track the knitters' sequences of actions. While experimenting with the theramin (sofware: PhysMo v2), selected frames were chosen to create an action sequence shot. The frames show how the different knitters tried to make sense of the audio feedback of the theremin, by moving their body accordingly.

Results

Improvisational Creativity Through Awareness of Epistemic Actions

Through the analysis of data an awareness of epistemic and pragmatic actions surfaced. According to Kirsh pragmatic actions are referring to those taken to implement a plan – in the context of knitting, to add stitches. By epistemic actions he is referring to all the actions that seem to bring the agent closer to the goal – pulling the yarns, shifting the needles. The knitter's perception changes, in these transitional moments, between the previous and next action, which challenges their creativity during the process of making.

When the impact of their activity was not solely translated into a yarn but also a musical pattern, knitters tried to adjust their skills to the new setting in various ways, from rhythmically pulling the yarn, to altering the knitting angle (from a static horizon plane to the vertical one). Even employing their whole body to dance, or jokingly responding to the musical output of the knittstruments.

Knitters exaggerated their movements in their attempt to make sense of the audio output, shifting over from one side of the instrument to the other. In doing so knitters built upon their skills practices. The direct coupling between action and perception, through sound, brought them out of the flow state (Nakamura & Csikszentmihalyi, 2002), which let them experiment and, during the process, improvise with all the tools available (yarns, needles, sound, body).

Knitters Weave Melodies Out of the Flow State

Knitters were aware of the importance of their skills without necessarily being able to perform. While knitters were experimenting with their knitting

Participants

Participants belonged to two knitting clubs. All of them were women (approx. 40 in total) of varying ages. The focus group were *professional* knitters who had the flow of knitting and, at the same time, the possibility to transform their knowledge into music. All the members of the club that participated in the research are experienced knitters, working on different projects at the same time, with different techniques.

Environmental Setting

For the interactive nature and its impact on the knitting experience to be thoroughly explored, three creative scenes were designed: a cozy living room, the stage of a music club and a public space within a hall during an electronic music festival (DEFINE). These were located in the Danish town of Sønderborg, chosen to accommodate knitters (woman with an average age 60) and knittstruments to improvise onstage spontaneously creating a performance (Images 1-3).

Image 4

Image 5

If you have done sufficient of these patterns then you start thinking this is not quite what I wanted to do. And then the more creative process starts. It's not like when you are ten [years old]. I am 48 and I have been knitting my whole life and still I am at the same level in the creative process, as this wonderful lady here. I am still lacking experience.

If you have done enough of these patterns then you start thinking this is not quite what I wanted to do. And then the more creative process starts. Now I am doing something creative, for example these patterns here. The idea of how to make a cape in this way I got from a designer, but I wanted to make my own pattern, although I am not so creative that I can construct my own. What I do, is I take patterns from other things. This is embroidery from 1760. Then I took a picture, and then I made my own knitting pattern. This is half-creative, because I am stealing patterns from everywhere.

Another interesting aspect of the project is that the potential collision of digital technologies with craft practices can reveal new design opportunities. Digital tools can unlock participants' creativity based on improvisation during the process of a knitting piece, and may do so in other crafting practices.

There are various projects that represent the process of knitting and the rhythm of bodily movement, through visual or audio representations, but there is no link to creativity. *The Movement Crafter* (Pschetz et al., 2013) or *Knitting Sound* (Interaction Lab, 2014) are projects that aim for a physical representation of bodily movements. The visualisation presents a complementary output for the knitting activity.

In this research, we don't see the body as the fence between the inner and the outer world, but as something in between. The main focus here is not on the patterns and their creation, but on the individual bodily rhythm and the body as a tool in use during the knitting process. Results from this research showed that the knitters' awareness of their bodily movement affected their performance and enhanced creativity, based on improvisation during the process of knitting.

The knitters built upon their skill practices. The direct coupling between action and perception, through sound, brought them out of the flow state, and let them experiment and improvise during the process with all the tools available (yarns, needles, sound, body). In contrast to freestyle knitting, where improvisation lies on the free form of a knitting pattern and leads to a new pattern, here, every change of bodily position changed the sound output and triggered the next action.

One of our observations was that conversation among participants was scarce during their musical performance. The reason for this behaviour was not obvious, but we estimate that as every new skill activity requires a matter of practice, knitters have to familiarise themselves with the instruments to then be able to perform.
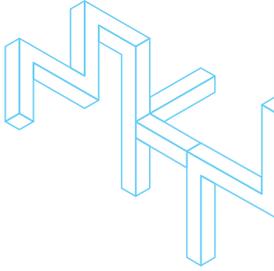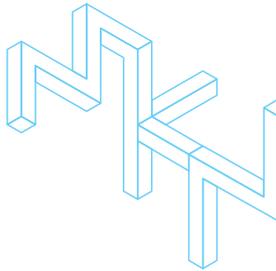
practices and the new setting, we identified physical tension, as their body was moving. They were experimenting, not only with their hands, but with their whole body, the selected yarn and the knitting sticks. Knitters left the state of flow and became present in the new activity. After the performance, informal talks documented that they really enjoyed that they could 'sound'.

Knitting is Communication and Participation
Knitting implies social spaces and usually creates sites for conversation. This activity is usually accompanied by chatting among participants (Image 5). We observed that this was not the case when knitters faced the need to express themselves musically. Instead of creating a common knitting structure, the knitters created a musical pattern based on their bodily movements. Conversations were scarce and brief, which may be due to the increased demand for attention.

Discussion
The goal of the knittstruments was to explore how knitters can translate their embodied skills into new practices, by directing perception and action through auditory feedback. This research aimed to unlock alternative ways of creativity based on individuals' embodied knowledge. An interesting topic emerging from the literature review, and the interviews conducted with the participants, is the meaning of creativity in knitting. Reflecting on this, two of the interviewers mentioned that in order to be creative, one has to have a lot of experience and ability to create one's own patterns.

Reflecting on the artefacts that we selected to conduct the current research, the feedback we got from the audio output of the theremin was not so positive. A theremin is one of the most difficult instruments to play with and presents a lot of technical difficulties (Glinsky, 1992). While one hand controls the pitch and the other the volume, the distance between the two hands remains always around 50cm, whereas in knitting, the hands are in close proximity to each other. Transforming the knitting and the bodily patterns into harmonic sound with the combination of a theremin and digital filters is a challenge that design practitioners could take into consideration.

Future Work

The knittstruments are subjected to an ongoing process of modification in order to smooth the interaction between user and artefact, which is currently computer driven. Sensors are being deployed in the needles to reduce the separation between customary knitting and audio output and software alternatives (Max MSP as opposed to Ableton Live) are being explored.

The social interaction among knitters is also part of our future work. Current prototypes intend to improve the governance of the knittstruments, providing better *global* feedback among knitters in order to be able to compose sound together while working on their physical pieces alone.

An interesting application of the work presented in this paper is the possibility to transform other activities that rely on repetitive movements, such as physiotherapy, into creative activities.

Conclusion

The combination of action research and grounded theory helped us build the theory and the practice at the same time, based on the data that we collected. With this study we focused on a personalised way of knitting and the knowledge that the body has acquired through experience. Knitters became aware of their bodily movements, through the addition of audio feedback and started experimenting on their skill practices.

As a study of creative practice, our work presents a useful lens on knitters' creativity in the process of making. The study also questions the tools in use for knitting. We follow the notion of rhythmanalysis where the body is not simply analysed as a subject, but is used as the first point of analysis, the tool for subsequent investigations (Lefebvre, 2004).

Knitting needles, yarns, sound and the body itself, are the instruments of the knitting composition. This research gave an overview of how we can stimulate creativity in knitting. We focus on the process of making, the embodied knowledge of the knitters and the rhythm of the bodily movements. This study is not, for the most part, another attempt to visualise the bodily rhythm of knitters (*Movement Craft,* 2013; *Knitting Sound,* 2008), but an attempt to extend the

knitters' creativity, through the awareness of their bodily movements.

In this paper, we explored the possibilities of coupling the methodical activity of knitting and that of audio generation. Three different instruments (knittstruments) served as a tool to bridge the gap between merely producing a yarn pattern and generating an audio output. The behaviour of the knitters while performing in three different designed stages, as well as the shift in the perception of their accustomed working tool (knitting needles as tools for sonic composition), opens up new design possibilities.

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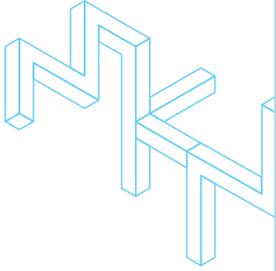
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