3D Printers as Potential Boundary Negotiating Artifacts for Third Places

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Abstract
Third Places are informal gathering places in which people gather between home and work. Based on findings of our empirical study we uncover that most of the characteristics of Third Places also fit in 3D printer communities. With this paper we want to discuss the question if and how 3D printers and/or other maker machinery might act as potential boundary negotiating objects which form new third places or transform existing ones.

Author Keywords
Third Places; 3D printing; boundary objects; communities.

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H.5.3 Group and Organization Interfaces

Introduction
Following Oldenburg (1999) Third Places are informal gathering places in which people gather between home (First Place) and work (Second Place). He suggests that due to a healthy existence and to positive coping with stress, citizens must organize their lives in a balance between three dimensions: (1) The private home life, (2) the workplace, and (3) public sociable places in between. Those public sociable places in between can be characterized by eight tightly connected criteria like having a neutral ground or the main activity being conversation [3].

Access to digital fabrication technologies like 3D printers has become a more and more widespread phenomenon in recent years. It is no longer limited to highly professional organizations but also to smaller businesses and especially to consumers, prosumers (semi-professional users) and hobbyist maker

communities - digital fabrication technologies become increasingly democratized. They also represent a quickly evolving field whose values, challenges, practices and socio-technical aspects are also evolving which make it such a fascinating field of research.

We recently uncovered existing practices and technical approaches of 3D printer users and communities as a whole in two different 3D printing communities in Germany [2] with a focus on how those communities appropriate 3D printers and how to support those appropriation activities. This study was focused mainly on work contexts (or second places in Oldenburg's terminology). However, we also found that those communities seemed to exhibit some characteristics not necessarily associated with work places in general like the tendency to "hang out" in the vicinity of the 3D printers as well as a significant amount of tinkering, playing around, informality, ludic engagement and related (semi-)private conversations between community members. The main differentiator between our communities and the office spaces next to it was the presence of 3D printers which made us curious and led us to suspect that such 3D printers (and possibly other Maker machines) might hold the potential to be the basis on which a Third Place might form - to act as a boundary object [4] in the making. To facilitate a broader view on this topic, we will look at each of Oldenburg's criteria for uncovering matches to our findings. Given the work-related focus of our main study, we will also supplement potential mappings with information from our loose inquiries into Hacker- or Makerspaces as well as FabLabs as non-work related environments.

Boundary Objects in HCI

First we must give a short recapitulation of the concept of "Boundary Objects" [4]and its pertinence to our topic. Boundary Objects describe material artifacts in work contexts which help establish coordination between different groups or communities in that they are plastic enough to take on different meanings for persons with different backgrounds, yet also retain enough of a commonly recognized structure to facilitate coordination and communication. The concept has also been extended by Lee in 2007 into more chaotic, less structured environments and as a means to establish and negotiate boundaries instead of only enabling cross-boundary communication [1]. Especially this view is relevant for our purposes since third places are less structured than work contexts and we are interested in how 3D printers might help establish or develop the boundaries of a third place as well as facilitate the communication in it.

Setting of our Empirical Study

We conducted an empirical study in two different 3D printing communities in Germany. The first is a community centered on Human Computer Interaction researchers at our local University. The second community consists of artists at a German Academia of Media Arts. The group of our local University share a so called HCI-laboratory, where two Fused Deposition Molding (FDM) printers (MakerBot and MakerBot 2X) and one full color powder composite printer (ZPrinter) are available. Beside the printers, also soldering iron stations, a drill press as well as other tools for manipulating hardware exist. The group of artists has just one FDM printer (MakerBot 2). We conducted a Grounded Theory oriented approach [6], where we did not explore the field with predefined categories but

derived categories from empirical data. To reconstruct the practices we used observations, workshops as well as interviews. The observations (10 hours, both communities) were used to acquire knowledge about practical work in 3D printing and its process. The workshops (2 workshops, 2 hours each) allowed us to understand the communicative practice of printer-specific knowledge and information sharing. The interviews allowed us to analyze the work context and the use of printing tools and communication systems of relevant users. The semi-structured interviews lasted about one hour each and followed a guideline.

Towards the Characteristics of Third Places of 3D Printing Communities

As mentioned, Oldenburg defines Third Places by taking eight characteristics into consideration [3]. We will discuss them critically with regard to their matching of 3D printing communities and 3D printers themselves. All page numbers in the following section refer to Oldenburg's book *The Great Good Place* [3].

On Neutral Ground

Third places must be neutral ground in order for the city and its neighborhoods offering rich and varied association. *"There must be places where individuals may come and go as they please, in which no one is required to play host, and in which we all feel at home and comfortable"* (p. 22). Those neutral grounds can be for example restaurants, bars or hotspots in central parks. Right now 3D printers are closely associated with open spaces like FabLabs or Hackerspaces, where everyone is welcome and nobody is forced to take on any role or embrace any value (apart from being free from prejudice). This neutrality is also incorporated by a lot of open hardware 3D printers through their conception and their purpose which is also comparatively neutral: They can be used to make almost everything from task-related objects to art to replicate themselves, serve as a basis for tinkering or simply attract fasciation and ludic engagement.

Conversation is the Main Activity

"Neutral ground provides the place, and leveling sets the stage for the cardinal a sustaining activity of third places everywhere. That activity is conversation" (p. 26). The spaces we researched in our empirical study were originally conceived as working areas, but currently they are widely used as (in)formal meeting grounds. Almost the whole day someone "hangs around" at the laboratory and students as well as senior researchers get in contact and communicate in a very informal manner and even about many private topics. This usage of the space closely resembles that in completely non-corporate Hack- or Makerspaces and started only after the 3D printers were acquired. Conversation and discourse are also often facilitated through the 3D printers. Here, we identified a barrier to entry into the community which is the frequently used domain-specific vocabulary, which needs to be reduced (possibly through ICT) in order to facilitate a completely open access to the conversations in a manner appropriate to a third place [2].

The Third Place as Leveler

A Third Place must be a leveler where *"a place that is a leveler is, by its nature, an inclusive place"* (p. 24). 3D printers can be mainly found in closed industrial organizations or open source communities. Focusing on the second group, the spirit and ideology of those open source communities level all participants and interesting people. Sharing, open community,

participation and engaging are the keywords characterizing Hackerspaces or FabLabs. Those organizations are non-judgmental and very open for all genders, orientations, ethnics, ages, etc. and give everyone the opportunity being part of that informal community. 3D printers as physical artifacts also embody this spirit and consequently seem fitting as boundary negotiating artifacts for third places. However, we found that while inclusivity is a value embodied in 3D printers, its execution is still lacking, for example because of certain requirements regarding technical knowledge, perceived expert statuses or (not) easy access to contextual printing information. It can be observed that 3D printers seem to evolve quite quickly in a direction to alleviate these issues and we try and help along this process through our research.

Accessibility and Accommodation
"Third places that render the best and fullest service are those to which one may go alone at almost any time of the day or evening with assurances that acquaintances will be there" (p. 32). It is quite usual that spaces with maker machines are open around the clock. If members of those communities are available, the space is opened which is comparable to a coffee shop which is only open when the owner is available. The HCI-laboratory at our local University can also be considered an open space. The keys of the laboratory are shared to around 60 research and student assistants, so even if the laboratory is not completely open to the public, it is open to quite a substantial amount of persons from the local community, especially considering the fact that the key owners regularly open the laboratory for non-key owners, too. We observed in our study that attendance seemed quite widespread and transcending traditional work hours even in our work-related settings – sometimes student assistants and their colleagues might walk into the HCI-lab at 10pm in the evening and find a relaxed crowd chatting and tinkering away. This phenomenon is even more distinct in non-work related settings.

The Regulars
"The third place is just so much space unless the right people are there to make it come alive, and they are the regulars" (p. 33). Such regulars can also be found in the context of 3D printing, where they are mainly experienced people with expertise of how to operate the machines, work on them or make 3D models. This expertise is grown from experimenting and private usage motivations to a semi-professional operating:

"Then somehow over time, we got around from this hobby and side projects to learning more and more about how we can work with the thing [the printer] and also started to deal with 3D modeling, how it all works [...], how to clean the printer, maintain it and what to do when it will not work and so on." (I02)

This statement shows clearly that *"every regular was once a newcomer and the acceptance of newcomers is essential to the sustained vitality of the third place*" (p. 34). Even if the regulars are not trained in how to appropriately teach, they spent much time in introducing, explaining and presenting the 3D printer practices and attracting and engaging new members of the community. Due to the close association with open source and sharing, the "experts" are often generous with advice and tips.

A Low Profile
"As a physical structure, the third place is typically plain" (p. 37). The environments of 3D printers often concentrate on its substantial. Beside the 3D printer, there are often just tools helping to create and modify artifacts. Compared to a bar where the food or drinks are the main objectives, tools like knives, forks or spoons, the glass or chairs and tables help modifying those objectives. In environments of 3D printers, available tools are e.g. soldering iron stations, a drill press or binding glue.

"In cultures where mass advertising prevails and appearance is valued over substance, the third place is all the more likely not to impress the uninitiated" (p. 36). We found that this often is not really achieved in 3D-printing related environments. The appearance of the machines is often futuristic or technical which can be daunting for the "uninitiated". However, there seem to be trends to make some printers more unobtrusive, sleek and inviting regarding shape and ease of use – we can corroborate the importance of this trend through our ethnographic research.

The Mood is Playful
"Whether pronounced or low key, however, the playful spirit is of utmost importance. Here joy and acceptance reign over anxiety and alienation" (p. 38). Unlike normal printers or office tools, which are used only for practical reasons, the printing with 3D printers evokes a lot of fascination for the users and interested people through printing itself as well as observing and engaging with the process (associations with Replicators from Star Trek have been made).

"What really fascinates me on 3D printing is that you can finally create something on the laptop, which you can later hold in your hands, except a hardcopy. One has the feeling of having created something, so it is not comparable to creating just a graphic on the laptop: You can touch it, which is just so exciting." (I07)

The curiosity and above all the private playful interests are the main motivational factors for engaging with such novel machines (I02) and seem like a key factor in the closeness of 3D printing environments to third places: Examples of engagement include private artifacts such as a camera cover (I01), testing the functionality of printing a Minecraft landscape (I02) or the printing of jacket holders for the office (I03). As already mentioned in the statement of I02, we see that 3D printers seem to possess the potential to transform a community, to engage it in activities and to keep the mood playful all the way.

A Home Away From Home
"Though a radically different kind of setting from the home, the third place is remarkably similar to a good home in the psychological comfort and support that it extends" (p. 42). This is probably the aspect where 3D printers can have the least amount of influence on a third place. However, aspects mentioned before, especially in *Accessibility and Accommodation* seem to indicate that 3D printers can help form an including, welcoming community accessible at many hours which can probably lend people a certain amount of comfort and backing like many communities can do.

Discussion of Potentials of 3D Printers as Enablers for Third Places

Our empirical study and the mapping of Third Place characteristics to places of 3D printing communities show that besides a few differences, Third Places and places of 3D printing communities have many aspects in common. For example one of our main empirical results shows that digital fabrication technologies like 3D printers evoke a high level of playful motivation to operate and explore them. This playful motivation fosters engagement and involvement of such machines and related devices. In contrast to machines like "2D" laser printers, 3D printers can function as enablers for a building communities or the development of an existing community. A common reason for people with varying backgrounds to approach or enter Third Place like communities such as Hackerspaces or FabLabs is often found in the presence of a 3D Printer. The machines, their applications and the produced artifacts are often main topics in spaces like the researched HCI-Laboratory, also when interacting in heterogeneous groups consisting of technical as well as non-technical people. However, those topics also tend to wander in a more holistic, integrative manner and to include private subjects as well. Taking the aforementioned aspects into account we argue for considering 3D printers as potential boundary negotiating objects for Third Places as less structured environments than e.g. work environments in that the 3D printers can either be initial sparks for a new Third Place or extend an existing one.

As an outlook on what we might do with our findings and ideas: Based on the gained knowledge, we propose an experimental placement of 3D printers into previously unrelated settings. As an example, we think here of integrated generation-spanning housing projects which sometimes incorporate Third Places in the form of common rooms for the neighborhood since we already have access to such a housing enterprise through another research project. Such a setting would yield more ethnographic results as to the viability of 3D printers as boundary negotiating artifacts and also help to craft and design their appearance and interfaces in a more integrative, low profile fashion by utilizing a Human Centered Design cycle.

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