

**Ph.D. in Information Technology
Thesis Defense**

**November 13th, 2025
at 10:30 am
Room BIO1 – building 21**

Giacomo CASLINI – XXXVII Cycle

**Toward Expressive Autonomy for Neurodiverse Users: A Design Trajectory from
Creative Interaction to Adaptive End-User Development**

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Abstract:

The term Neurodevelopmental Disorders (NDDs) refers to a variety of conditions that arise during the developmental period, ranging from specific difficulties in learning or executive functioning to broader impairments in social interaction or intellectual abilities.

This doctoral dissertation focuses on leveraging Interactive Smart Spaces (ISSs) to support the well-being and autonomy of people with NDDs.

This work is structured into two main parts, reflecting an evolution of the research focus: Part I, "Multisensory Interventions in an Interactive Smart Space (MI)", and Part II, "From Design to Meta-Design (MD): User-Created ISSs".

The first part focuses on the development of an interactive activity for people with NDDs. The activity, implemented in the Magic Room — an existing ISS developed at i3lab and deployed in schools and therapeutic centers — was co-designed to foster social communication, emotional regulation, and well-being. This section reports on two evaluation studies conducted with users and discusses the resulting insights.

The second part of the thesis shifts the approach to engaging people with NDDs in the hands-on creation of ISSs by introducing meta-design tools. This shift aims not only to provide means for improving the well-being of people with NDDs but also to empower them to design their own tools and shape their technological landscape. Concretely, this takes the form of two tools for creating smart spaces.

MakeNodes is a tangible toolkit designed for people with intellectual disability (ID, a form of NDD). It consists of a set of sensing and actuating nodes that can be placed in the environment to augment physical objects and spaces with smart capabilities. The toolkit

was evaluated in three workshops, which also enabled a comparison of two interaction modalities and helped fill a gap in the literature by producing a set of design guidelines for people with ID.

Building on the experience with MakeNodes, a second tool, Smartifier, is introduced. It uses two LLM-based chatbots to support users in designing and implementing Interactive Smart Spaces, both in terms of enabling smart objects and system behavior. Through conversational assistance that adapts to user input, Smartifier aims to provide richer and more flexible support while preserving a high degree of expressive freedom. The tool was evaluated in a preliminary study involving 17 neurotypical participants.

The meta-design approaches presented in the thesis aim to increase technological competence in people with NDDs and, more importantly, foster a sense of autonomy, inclusion, and self-confidence. The results from the evaluations presented in this part are encouraging, and future work should assess the effectiveness and usability of LLM technologies for end-user development among high-functioning individuals with NDDs.

Overall, this work shows that Interactive Smart Spaces can meaningfully enhance well-being in people with NDDs through carefully designed multisensory activities, and that these individuals can also take an active role as designers of their own technological environments, given the appropriate support. The findings contribute both practical tools and methodological insights for the design of inclusive, user-developed ISSs. Future research will extend these interventions into new media, such as extended reality, increase the expressive capabilities of the toolkits, and assess their long-term impact in real-life contexts. Comparative studies between tangible approaches and conversational, LLM-based approaches will help identify the most effective pathways to foster autonomy, creativity, and technological agency among people with NDDs.

PhD Committee

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