Polymath interpolation for open-ended design, exploring artificial nesting design for the southern ground hornbill

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Abstract

Many of the challenges especially those associated with sustainability and conservation are indeterminate and wicked requiring the transcendence of typical disciplinary domains. This is both in terms of the teams and individuals associated with the solution development. The solutions themselves also need to be adaptable and open-ended. However, achieving open-ended solutions once again requires "openness" in who or how someone might develop a solution. This links to concepts like *DesignX* or what is referred to as *Polymath Interpolator Designers*. Following a *Research through Design (RtD)* approach addressing the sociotechnical challenge of conservation of the Southern Ground Hornbill bird, in particular the development of an artificial nest, the aim is to investigate the concepts of 'polymath interpolator' design.

As a result of habitat loss, among other factors, the Southern Ground Hornbill has seen a rapid decline and is at risk of becoming critically endangered. Artificial nests have been shown to be an important tool in the conservation of the species, especially in areas where no natural nests in sufficiently large trees are available. The adaptability of the nest solution needs to consider new and emerging contexts as well as future scenarios necessitating an open-ended design. This acknowledges the inherent complexity of the design challenge and avoids potentially linear processes, because of specialisation, where a singular limited purpose design is produced. Alongside the primary focus of an artificial nest, many related challenges could be addressed simultaneously, enriching the primary solution. This 'branching and re-joining' are in fitting with the polymath design approach, arguably allowing openness not only in the solutions, but also in the problem identification and scope of engagement. Thereby offering many opportunities for understanding and articulating the concepts of 'polymath interpolation' in a transdisciplinary context while developing open-ended design solutions.

Author keywords

Transdisciplinary; open-ended design; polymath interpolation; conservation; Industrial Design.

Introduction

"Designers no longer fit neatly into categories such as product, furniture and graphics; rather they are a mixture of artists, engineers, designers, entrepreneurs and anthropologists" (Dykes et al., 2009, p. 101). Seymor referred to by Dykes et al says that in design, there appeared to be a trend to two types of designers, "specialist executor" and "polymath interpolator" (Dykes et al., 2009, p. 101). When you dissect the term of "polymath interpolator" the concept of polymath, suggests transcending disciplinary domains, while the concept of interpolator implies 'filling the gap'. "Filling a gap" should also be interpreted as a transient adaptable solution, in other words an open-ended design.

In the *Global South* increasing levels of development results in habitat loss for different species (Skowno, 2019, p. 68). For certain species this can cause dramatic losses in numbers. One such situation is the *Southern Ground Hornbill*, *Bucorvus leadbeateri*, which in South Africa is listed as endangered. This decline has been rapid, with 50% decline in the last few years (Whitley Awards, 2021). One of the identified strategies for reducing the decline and ensuring sufficient genetic diversity, by linking protected reserves, is to provide nesting opportunities for new groups. A key solution is that of an artificial nest where large enough trees are not available. Typically, the Southern Ground Hornbill nests in a hollow of a tree formed when a branch breaks off, allowing rotting. However, these hollows need to be big enough for the nesting birds, approximately 100cm tall, and therefore requires trees of a certain size and age. Where these trees are not available artificial nests need to be provided.

However, the challenge of the design of these nests is complex in that there are many factors that influence the design. This includes, how they are made which aims to utilise volunteers in the construction, the materials and strength, the ventilation and cooling, and integration with broader conservation activities etc. There are also many emergent factors that are yet to be discovered during the continued efforts in the conservation of the species. This became evident as various nest prototypes were developed and distributed around Southern Africa. Looking retrospectively at past, as wells as using planned activities the aim is to further develop adaptable, contextually appropriate (open-ended) artificial nest solutions for the Southern Ground Hornbill while investigating and better articulating the concepts of *polymath interpolator design* in a transdisciplinary project.

* The study aims to be a cotutelle degree with the Tshwane University of Technology and Ghent University but at the time of writing this is still being established.

Framework

This study relies on a pragmatist epistemology, in particular a "Deweyan pragmatism" which "...regards ideas and theories as tools for action..." (Dalsgaard, 2014, p. 149). Taking the form of a *Research through Design* (RtD) study, undertaking the main as well as many sub- "... designerly component[s]" (Stappers & Giaccardi, n.d., p. ch 43.1.14) of developing an improved, context dependent and adaptable artificial nest solution for the Southern Ground Hornbill. Undertaking these "designerly activities" as part of the broader conservation effort, as a transdisciplinary project, aims to produce various practical outputs contributing directly (nest specific) and indirectly (related and linked) to the artificial nest of the Southern Ground Hornbill and the broader conservation strategy. In addition, the aim is that at the same time by reflecting on actions and vice versa, the concept of polymath interpolator design and its links to open-ended design solutions is better understood.

A Snapshot

As noted, there are often emergent challenges and consideration that we are currently unaware of. To a certain degree one might say the study aims to look at the continued "muddling through" and "satisficing" (Norman & Stappers, 2015, p. 93) in that there will be many occasions of acting opportunistically which is appropriate for the indeterminacy of the arguably wicked challenge (Buchanan, 1992, p. 16). The specific delimitation of the study is a snapshot of a three year, three breeding season period, which will occur across the general iterative process linked to the artefacts and prototypes which will reach a climax at just before breeding season each year, when the nest prototypes that are developed are possibly utilised.

Figure 1. The Initial Prototype - Photographs by Author

Past

This project began as what was incorrectly assumed to be a quick exercise in developing a new artificial nest using an alternative composite material strategy, building on previous work. The initial dimensions and need for nests were the result of a study of natural nests in the protected areas of the Kruger National Park (Kemp & Begg, 1996, p. 13). The Mabula Ground Hornbill Project (MGHP), a non-profit organisation with the aim to halt and then reverse the decline of the Southern Ground Hornbill, began developing artificial nests out of wood. However, the longevity of wooden solutions presented a problem for the 70-year lifespan of the birds. Initially the author ran a project with students developing an initial prototype made from a foam core coated in hessian fabric and an acrylic resin blend (Figure 1). Since then, more than 40 prototypes have been developed with many used by groups of birds (Figure 2) leading to many new discoveries from technical challenges with the materials and form, as well as how to include the participation of volunteers and community custodians.

Figure 2. Prototype Nest used by breeding group of Southern Ground Hornbills - photographs by Author

Planned

One of the challenges that has emerged is the cooling of the artificial nests. Natural nests that occur in trees are kept cool in high temperature environments by the structure and nature of trees themselves. Replicating this is the first step, however there is also likely to be a need for 'better than natural' cooling with increasing average temperatures influencing different bird species (Bourne et al., 2021, p. 1221). This challenge is multi-faceted in that previous prototypes have been seen to effectively insulate the interior of the nests from external temperatures however this same insulation also traps the heat of the nesting bird, once again increasing the temperature inside.

Another important consideration of these nests is that their materials be context dependant and appropriately (timescale) biodegradable. Some of these nests would be placed in outlying locations where once they are no longer utilised should biodegrade and not pollute the location. In other contexts, there would be a much higher occupation and interaction rate (e.g. captive birds) which would necessitate possibly stronger materials. The specific strength of these materials is also something that needs to be more precisely determined. The birds tend to peck at the nest in what appears to be testing its integrity before using it. This pecking has damaged many of the prototypes previously developed, so having more precise data on the forces associated with pecking is important.

The broader conservation strategy of the Mabula Ground-Hornbill Project relies on education programs and volunteers (*Mabula Ground-Hornbill Project - Conserving the Southern Ground Hornbill*, n.d.). The intention is to rely on human effort for the production of the nests but require minimal skill and training. This does present challenges like quality control and accuracy. Accounting for these factors will influence a range of the different attributes from the material choices and strategy, to the form and construction/assembly technique. Planning for this will also aim to create a sustainable, decentralised production strategy for the nests which will also allow for appropriate adaptions for different contexts (Open-ended Design).

For this study, the initial focus would be to look retrospectively at past activities and attempt to map the cybernetic process associated with artificial nests solutions. This would be both in terms of the human interventions (activities of the conservation organisations, community custodians of nests etc.) as well as natural systems (weather, breeding patterns, behaviors etc.). Then using a range of disciplinary diverse design activities to develop tools, the aim would be to ascertaining guiding technical details like the noted, strength of materials or cooling techniques. Thereafter, additional design activities will continue iterating different nest solutions, considering the cybernetics and determined details, before determining the appropriate production strategy for these. As these activities occur the concept of 'polymath interpolator' designer will continue to be reflected on with the aim of developing a specific framework for 'polymath interpolator' design in a trans-disciplinary project aiming to develop open-ended solutions.

Conclusion

The sociotechnical challenge of developing artificial nests for the endangered Southern Ground Hornbill presents an opportunity to not only contribute practical outputs in the form of prototypes and artefacts but also better understand polymath interpolator design(ers) and how open-ended solutions can be developed. Understanding open-ended solutions and the approach to achieving them is important for the many sociotechnical challenges we face, especially those associated with conservation and sustainability. This study aims to show the importance of non-specialist approach where the solutions may not be optimal but offer a way to 'satisfice' while we 'muddle through' the complexity of the challenges we face.

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