Title	
Author(s)	Tessier, Matthieu
Citation	
Issue Date	2018-06
Type	Thesis or Dissertation
Text version	ETD
URL	http://hdl.handle.net/10119/15428
Rights	
Description	Supervisor: 　　　　　, 　　　　　,

JAIST

JAPAN
ADVANCED INSTITUTE OF
SCIENCE AND TECHNOLOGY

Japan Advanced Institute of Science and Technology

氏　　　　　　名	Tessier, Matthieu Claude
学 位 の 種 類	博士（知識科学）
学 位 記 番 号	博知第 229 号
学 位 授 与 年 月 日	平成 30 年 6 月 22 日
論 文 題 目	The Design of Tangible Interfaces' volumes and geometry: Effects on discoverability and cognitive load
論 文 審 査 委 員	主査　宮田　一乗　　　北陸先端科学技術大学院大学　　教授
	永井　由佳里　　　同　　　　　　　　　　　　　教授
	西本　一志　　　　同　　　　　　　　　　　　　教授
	金井　秀明　　　　同　　　　　　　　　　　　　准教授
	Grégoire Cliquet　L'Ecole de Design/Nantes Atlantique
	教授

論文の内容の要旨

　　　　In our daily life, it is not considered a challenge to interact with our immediate surroundings that comprises of doors, light switches, coffee cups and any other utilitarian objects. Nobody is really questioning the shapes of a tea mug outside of its aesthetics. All objects that are acted upon obey some underlaying logics that, even if not visible, are communicated via these objects' forms. This is known as affordance, or the capacity for an object to communicate on its potential usability through its design. If users find themselves in the incapacity to properly use a simple object like a door, it is not the fault of the users. If someone attempt to open a door by pushing on it and nothing happens, the only remaining solution is to pull on it. This is sometime frustrating but not impossible to figure out. This school of idea is applicable to any tangible object, but what about the things that are intangible?

In the realm of interaction design, tangible interface is a bespoke artifact created to offer a physical interface to interact with. It has the same purpose as graphical user interface, to communicate on what is available to the user and how it can act upon digital content.

The subject and purpose of this study is at the crossing of these two ideas: If the mechanics of design (affordance) were to be applied to digital content and tangible interface, what shape would such object take? Could that shape help the user connect better with said object, to have a more enjoyable and engaging experience?

Current works on tangible interface focuses on how they render interaction easier and more natural due to direct physical manipulation. This is being explored in varying ways, either by proposing 1) interpretation of a known subject (physically manipulating a landscape) or 2) creating bespoke object with innovative ways to interact with content (manipulating a toy to learn about complex subjects).

Such object is designed to represent its function(s), but its study focuses on the effect of its tangibility and mostly disregard if the design and aesthetics of the object has some effect. It is a study of objects' function over the possibility to study an ensemble of factors.

The study of design shows that good design should be a combination of practicality and enjoyment, simplicity and strong connection with users.

For this study, several experimental tests were ran, in an attempt to understand if there could be some relationship between the shapes of tangible interfaces and how users would perceive those interfaces. Three experiments were performed, each employing dedicated objects aimed at studying two facets of this study: 1) Can the shape of an object affect how participants would move in space, questioning the relationship participant/object/space. 2) Can participants abstract some mental representation out of an object, how does it affect their perception of said object (what is it for, how could they use it).

For the second part, due to relying heavily on how participant would process cognitive load, three age groups were tested, to verify if cognitive development and age would have an effect on how an object would be perceived and interpreted.

Results suggests that some types of shape would have an effect on how user behave, inviting them to move in predetermined ways (forcing them to look closer, to move their head to either side of the object). It also suggests that across all age groups, users are able to abstract the shape of objects and connect it with potential actions and interactions. It also shows that if visual support are applied, user's focus will shift to the images and affect how they would perceived the same object.

This would mean that, if appropriately designed, tangible interfaces could not only allow user to better connect with their object (physical manipulation) but also guide them in how to use or behave with that interface and offer a geometry onto which they could project its potential interaction(s), reduce the necessary connective process (if the object communicates properly on its potential) and allow for a better enjoyment of the interface.

Keywords: Tangible interface; Affordance; Discoverability; Design study; Interaction design.

論文審査の結果の要旨

　我々の日常生活には、ドアやコーヒーカップなどの実用的な人工物で構成されているが、誰もその形に疑問を呈していない。多くの人工物は、それを介して人の行動を喚起する潜在的な情報を有する。インタラクションデザインの分野では、グラフィカルユーザーインタフェースとは異なり、物理オブジェクトを介してデジタル情報を操作するタンジブルインタフェース(Tangible Interface)というコンセプトがある。本論文は、タンジブルインタフェースにおいて、どのような概念メカニズムが操作者の認知に影響を与えるか、インタ

フェースに用いる操作対象の物理オブジェクトの形状が人の行動にどのように作用するのか、を探求したものである。

　論文では、多岐に渡る美術館や博物館での展示形態のケーススタディを経て、タンジブルインタフェースに対する操作者の振る舞いにおいて、以下の２つの仮説を提唱した。

　H1)オブジェクトの大きさと形状は、ユーザの振る舞い影響を与える

　H2)操作者はオブジェクトに関連するデジタル情報の操作を知覚することができる

　上記の仮説に対し、以下の３つの被験者実験を実施した。

　E1)形状の大きく異なる４つの物体(表面は白地)をテーブル上に横一列で並べ、それらを観察する

　E2)同一サイズの底板上に設置した起伏や複雑さの異なる複数の多面体スクリーン(表面は白地)上にプロジェクタでドットやカラーバーを投影し、それらを観察する

　E3)同一サイズの底板上に設置した、1)平板、2)中央が盛り上がった４面板、3)中央が山のように複雑に隆起した形状のスクリーン(表面は白地)上に、テキストや動画、天気図などの８種類のコンテンツをプロジェクタで投影し、スクリーン形状の適不適を評価する

　延べ150名の被験者による実験結果を統計分析することで、提唱した２つの仮説に対し、1)オブジェクトの顕著な特徴がユーザの身体動作を誘発する、2)オブジェクト(情報を表示するスクリーン)の形状が操作対象であるコンテンツに適したものであれば、操作者は操作以前に操作内容を容易に想像することができる、と結論づけた。

　以上、本論文はタンジブルインタフェースおける操作者の振る舞いと認知への影響を探求したものであり、得られた知見はヒューマンインタフェースの研究に貢献するところが大きい。よって博士（知識科学）の学位論文として十分価値あるものと認めた。