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THE ROLE OF "GOOD" BEHAVIOURS IN BEHAVIOURAL DESIGN

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ABSTRACT
Interacting with a physical product is a continuous process where both good and bad behaviours co-exist and constitute the interaction. In Behavioural Design (BD), bad behaviours are also termed problematic behaviours (PBs). Correspondingly, good behaviours are termed non-problematic behaviours (N-PBs) in this paper.
Designers focusing on BD have developed various methods to change PBs, but few have clarified the role and function of the co-existing N-PBs in a given context. Accordingly, this study explores the role of N-PBs in the domain of physical product-related behaviour design (PrBD).
Through interdisciplinary discussion on Cognitive Psychology, we noticed that N-PBs can not only serve as routine actions, but also as contextual cues for users to identify and understand the changes of the target product.
To further explore the role of N-PBs in practice, we conducted a tweezer-chopstick experiment. The findings revealed that participants paid more attention to the changed structures that enabled them to complete the food-picking task. However, the retained features that associated with the N-PBs dramatically influenced their reinterpretations of the redesigned tools' practicality within the target context.
The contribution also highlights the consideration of N-PBs in design education. Designers working on user behaviours should not only focus on developing behavioural interventions to change PBs but also paying attention to the N-PBs in the given context, which could preserve the achievement of expected behavioural outcomes.

Keywords: Behavioural design, product design, problematic behaviours, non-problematic behaviours

1 INTRODUCTION
Behavioural Design (BD) takes user behaviours as the design centre [1], which is distinct from general design practices where the influence on user behaviours may occur as a side effect in the design process. Designers working on BD (i.e., behavioural designers) develop various approaches based on the understanding of present behavioural patterns to reframe user behaviours [2]. By restructuring the artefacts that users interact with, they design to constrain behaviours that can cause problems to livings or surrounding environmental elements (i.e., problematic behaviours or PBs), and activate expected behavioural responses (i.e., target behaviours) in the given context [3].
In this study, we discuss BD with a specific focus on physical products, as these physical artefacts are inextricably bound up with, and help shape, people's everyday behaviours [4]. Accordingly, our research concentrates on the physical product-related behavioural design (PrBD), exploring the issues of
user behaviours in interaction with everyday products, and we specifically explore the physical product-related behavioural design (PrBD).
Interacting with a physical product is a continuous process [5], in which both good and bad behaviours coexist. In BD, bad behaviours are problematic behaviours (PBs), while the coexisting good are those cause less problems than bad [6]. In this study, the good behaviours are termed non-problematic behaviours (N-PBs).
PBs and N-PBs are not independent behavioural categories; instead, they are closely interrelated and intensively dependent on the context in which the interaction occurs and the criteria defined by designers. For example, an average time of watching TV for 3.6 hours per day is acceptable for adults (N-PBs) but can be unhealthy for children (PBs) [7]. Despite the flexibility of behavioural evaluations,

what remains certain is that PBs and N-PBs together constitute users' continuous interaction process with physical products in a given context.
This study discusses PrBD through the lens of this continuous interaction process, particularly exploring the role of N-PBs, these good behaviours, in the design of user behaviours.

2 LITERATURE REVIEW

2.1 N-PBs in Behavioural Design

Practice-oriented researchers put forward a practice theory-based approach, directing practitioners on helping users establish new and expected practices through exposing them to the elements of the target practice. For example, they deployed a water container in the traditional showering context to encourage users to form a new practice called splashing, aiming to replace the traditional showering practice with a more water-saving one of splashing [8].
During the process of establishing the new practice, designers noticed that users were reluctant, and even refused, the new practice due to the insufficient support for them to reconfigure the changed elements in the new body washing context. For example, designers stressed the necessity of removing the shower for establishing the new practice, however, the removal of the essential element, plus the introduction of the new element of the container, discouraged their engagement in forming the desired practice. As the design iterated, to address the issue of users' dislikes of the intended practice, designers reintroduced the shower structure [7].
Although the practice-oriented approach indicates a process of integrating new elements into the original practice, designers neither elaborated on a systematic design process nor included a design step to direct designers to consider the integration operation. Instead, this process is conducted by users to improvise according to their perceived reconfiguration of the newly introduced elements, which is flexible but beyond the design control and can cause other unexpected behavioural issues, such as emotional rejection.
Affordance-based approaches reframe user behaviours by editing the perceived action possibilities offered by a product. The intensive link between the action possibilities and the physical objects is termed the affordance [9]. Designers can transfer affordances from different products to induce expected behaviours or prevent undesired ones [10] or edit the nested affordances to script user behaviours in a given context [11].
However, deliberately designing affordances can lead to a gap between the affordances perceived by users and that offered by products, causing behavioural issues such as misoperation [9]. This issue may become more pronounced when affordances are transferred across products from different use contexts. Affordances are context-dependent [12], so changing the contextual information could lead to perceived contextual conflict of the designed affordances between what is perceived within the target context and what the product offers.
For instance, when fruit skins were directly applied to the industrially produced juice packages to evoke freshness (see Table 1), the perceived contextual conflict between the industrial packaging and the natural textures of fruit skins could disrupt the transfer of intended affordance and annoy and discomfort users [13].
The design issue highlights a need to balance the affordances introduced with the retained pre-existing behaviours (i.e., N-PBs) within the given context.

Figure 1. Juice Skin Package. @ Nina Pope

Both practice-based and affordance-based design approaches touch on the design issue caused by the perceived conflict between the designed target behaviours and the user's pre-existing behaviours (i.e., the N-PBs) within a given context. However, neither of these approaches offers a systematic discussion of addressing the behavioural conflict through design. Instead, they take the N-PBs for granted in the design process or treat them as negative interferences that hinder the achievement of target behaviours. This overlook can lead to other issues, such as emotional rejection and misoperations, which can undermine the design outcome.

Within this background, Philip Cash's behavioural design method, which is developed through distilling common features from successful BD cases, offers a partial but relevant step that indirectly encourages designers to pay attention to the role of N-PBs in PrBD. In the method, Cash proposed a step called "behavioural specification", which emphasises clarifying and reconsidering the basic function of the target product in addition to merely activating expected behaviours [3]. For example, when designing to influence the street littering behaviour by redesigning a garbage bin, designers should consider not only the activation of the target behaviours, such as disposing of waste into the bin, but also the usability and the basic function of the target product as a traditional bin.

This step essentially encourages designers to consider how to balance the relationship between the designed target behaviours and the retained N-PBs, helping users cognitively reconfigure the elements of the new context and react to the redesigned product and behave as the design expects. Cash stressed that this step is essential to the success of BD [3]. However, he did not elaborate on the design operations to conduct this step, nor did he explain the underlying reasons why it contributes to the success of BD.

Therefore, although N-PBs indicate a significant influence on behavioural design in practice, their function has received little attention in behavioural design research.

2.2 Interdisciplinary discussion of the role of N-PBs

From the perspective of Cognitive Psychology, prior experiences often provide contextual information, helping people interpret the meaning of the present situation and understand the target stimulus within the given context. They tend to draw attention to the significant changes that can influence the perceived meaning of the context and show blindness to those unattended objects within a reliable situation [14]. Within this perspective, N-PBs can be understood not merely as routine actions but as contextual cues for users to identify and understand the changes of the attended target product. However, as identifying the contextual information is a mental process and can occur without one's awareness, users, even designers, can take the N-PB for granted and overlook its significance for BD.

From this perspective, the N-PB can be defined as pre-existing behaviours that are associated with the objects retained in a given context and is extended to include both the motor skills and mental actions in relation to these objects.

To explore the function of N-PBs in practice, a tweezer–chopstick experiment was conducted.

3 TWEEZER-CHOPSTICK EXPERIMENT

3.1 Experiment introduction

In this experiment, the tweezer structures were transferred into chopsticks to design for the disability of users who are unfamiliar with using chopsticks (i.e., PBs), enabling them to pick up food as proficient users would within a dining context. Combinations of different amounts of transferred tweezer structures and retained chopsticks features (i.e., N-PBs) represented a design process of balancing the relationship between the expected target behaviours (i.e., tweezer-use skills) and the retained N-PBs in the chopsticks-use context (i.e., chopstick-use operations and the perception of contextual information of using chopsticks).

Hence, through a qualitative exploration of users' tool choices and the underlying reasons for their preferences and interpretations of the tools, we gain in-depth insights into the role and functionality of N-PBs from a user's perspective.

The design process is visualised in Figure 2. Tweezers and chopsticks were divided into three equal parts in length. Different combinations of parts generated six redesigned tools, which have been named from T.1 to T.6. Together with a tweezer model, renamed T.t, a toolkit with seven tools was prepared for the experiment, as shown in Figure 3. All tools were created using the same wooden material, aiming to control the variables and ensure the picking functionality.

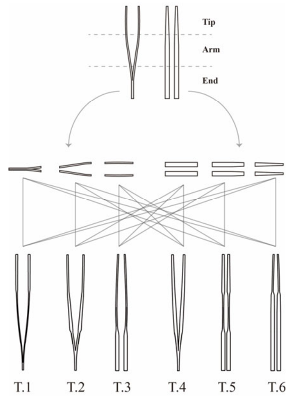

Figure 2. Tool designing process

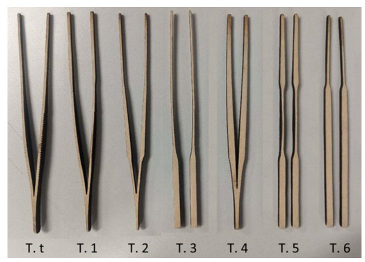

Figure 3. Recreated tools for the experiment. @ the authors

Additionally, this experiment took chopsticks as the medium to discuss the role of N-PBs in PrBD, rather than aiming to change the culturally symbolic utensil. Meanwhile, as the main researcher in this study is Chinese, the potential cultural risk caused by redesigning traditional chopsticks could be managed more appropriately.

3.2 Field test flow

The experiment recruited sixteen student volunteers, with twelve unfamiliar with using chopsticks (novice participants) and four familiar (proficient participants). All participants were individually invited to join the task.

During the experiment, participants were first required to choose a tool from the toolkit to simulate having a meal with the experimenter. They used the tool to pick up food from dishes and place it onto a plate, and this operation was repeated several times. Although the dishes provided were real, participants were not allowed to eat the food for real. Second, they joined an interview and answered questions regarding their preferences towards these tools, as well as the underlying reasons for their tool choices.

3.3 Interviews

The interview included two main parts. The first part contained questions exploring participants' preferences and reasons for their tool choices. The second part set two ranking tasks for participants, which served as task probes to detect their particular perceptions of tool usability and the similarities to authentic chopsticks.

The ranking of tool usability was aimed at exploring the perceived functionality of applied tweezer structures, which were associated with the expected target behaviours, i.e., tweezer-use skills. The ranking of similarity concerned the potential influences of the retained chopsticks features, which were associated with participants' mental interpretations of chopsticks, i.e., the N-PBs in the mental actions.

4 EXPERIMENTAL FINDINGS

4.1 Analysis of Interview Responses

Two key findings were identified from the analysis of participants' verbal responses in the interviews. First, the perceived usability of a tool is essential. All participants, including the novices and the proficient, chose a tool that enabled them to pick up food and complete the task. They all explicitly referred to usability as the essential factor they considered. Especially, they emphasised the connecting structure of tools, which enabled their picking operation. The results suggest that the connecting structure transferred from the tweezers would achieve the goal of behavioural design in this experiment. Second, although participants paid more attention to the changed structures, which enabled their food-picking operations, they also reinterpreted the practicality of a redesigned tool by consciously or unconsciously connecting it with the contextual cues of using chopsticks. For example, the novice No.16 stated that "I chose this (T.4, see Figure 3) because it is more like an actual chopstick". Similar explanations were also found on another two novices and one proficient participant. Proficient No.14 compared the holding gestures between using redesigned tools and using authentic chopsticks. Novice No.7 linked redesigned tools with the food commonly associated with authentic chopsticks.

When participants successfully connected a tool to the chopstick-use context through its retained chopstick features, they would accept it. For example, the novice No.4 stated that using a real tweezer was unacceptable in a real restaurant, but a wooden tweezer-like tool, such as T.t (see Figure 3), was accepted, as the wooden material associated him with real chopsticks.

However, when participants failed to connect a tool to the target context by its represented chopsticks features, they refused it. For example, the novice No.12 argued that although T.t was made of wood (similar to chopsticks), it still seemed like a tweezer rather than chopsticks, so she refused it.

Similarly, the proficient No.10 was in favour of T.4, as it was the "perfect thing" between a tweezer and the chopsticks and was comfortable in hand, he described. However, the participant No.15 refused it because she could not accept it holding gestures compared to using chopsticks.

Although participants might differ in perceiving the chopsticks features of tools, they relied on these retained features to reinterpret the tool's practicality and rationalise the changed structure within the chopsticks-use context.

4.2 Analysis of ranking results

The ranking results mainly focus on the available tools since, as discussed, the tools' usability is the most essential factor they consider. For novices, available tools are those with the connecting structure at the end part (see Figure 3), while these are extended to all tools for proficient participants, as they know how to use a tool with an open structure at the end part.

To facilitate the analysis of ranking tasks, the ranking results were coded numerically. Regarding usability, tools were assigned numerical values from 1 to 7 based on participants' ranking results, with 1 representing the lowest and 7 the highest in their perceived usability. Similarly, in the ranking of similarity to chopsticks, 1 indicated the lowest and 7 represented the highest similarity. Typical ranking results are shown in Table 1.

Table 1. Coding the ranking results of typical participants

Ranking results of tools' usability								
Tools / Participants	T.t	T.1	T.2	T.3	T.4	T.5	T.6	Tool choice
No.1	7	6	5	1	4	2	3	T.t
No.6	7	6	5	2	4	1	3	T.2
No.7	5	4	6	1	7	2	3	T.4
Ranking results of tools' similarity to chopsticks								
Tools / Participants	T.t	T.1	T.2	T.3	T.4	T.5	T.6	Tool choice
No.1	1	2	3	5	4	6	7	T.t
No.6	7	6	5	2	4	1	3	T.2
No.7	5	4	6	1	7	2	3	T.4

Although subjects emphasised that the tools' usability was the essential reason for their tool choices, the perceived chopsticks features could unconsciously influence their choices. For example, No.6 chose T.2 for its usability, but T.2 was not ranked as the most useful one, but the one more similar to chopsticks among available tools. A similar phenomenon occurred in another three novices and one proficient participant.

In addition, novice No.7 chose T.4, which he ranked as the most useful and most similar to the authentic chopsticks among the available tools. His ranking result was found among three other novices and one proficient participant.

Only three novices and one experienced participant had their ranking results aligned with their statement of usability for tool choices. For example, No.1 chose T.t, the tool most useful but far different from authentic chopsticks, as he ranked.
Therefore, the ranking results also demonstrated that the perceived chopsticks features, associated with N-PBs, dramatically influenced their preferences for redesigned tools. A tool that contained more chopsticks features would be chosen by more participants.

5 GENERAL DISCUSSION AND SIGNIFICANCE FOR EDUCATION

This study highlights the role and function of non-problematic behaviours (N-PBs) in PrBD. We found that N-PBs and the associated retained features of the original product play a crucial role in PrBD, which dramatically influence user's preferences and perceptions towards the redesigned products, which would further determines the effectiveness of behavioural design. In the experiment, the retained chopsticks features, which associate users' interpretation of using chopsticks, helped users reinterpret the tools' practicality within the chopsticks-use context. This evaluation significantly influenced the acceptability of tools within this context.
The contributions of this study are also significant to the design education. The theoretical and practical research suggests that, when designing user behaviours, designers should not only focus on developing and conducting interventions or strategies to activate expected target behaviours but also learn to balance the relationship between the target behaviours and the pre-existing behaviours, that is, N-PBs, within a given context. Learning to mediate such a relationship through design is critical for the success of the design for user behaviours.

REFERENCES

[1] Khadilkar P. R. and Cash P. (2020). Understanding behavioural design: barriers and enablers. *Journal of Engineering Design*, *31*(10), 508-529. https://doi.org/10.1080/09544828.2020.1836611.
[2] Nielsen C. K. E. B. B., Daalhuizen J. and Cash P. (2021). Defining the Behavioural Design Space. *International Journal of Design*, *15*(1), 16. http://www.ijdesign.org/index.php/IJDesign/article/view/3922.
[3] Cash P., Hartlev C. G. and Durazo C. B. (2017). Behavioural design: A process for integrating behaviour change and design. *Design Studies*, *48*, 96-128. https://doi.org/10.1016/j.destud.2016.10.001.
[4] Verbeek P.-P. (2005). *What Things Do: Philosophical Reflections on Technology, Agency, and Design*. Pennsylvania State University Press.
[5] Murata C. (2017). *Design of Behaviour Thinking 《让动作不NG才是好设计》* (B. Chen, Trans.; C. Yu, Ed.). Mai Tian Publisher.
[6] Elias E. W. A., Dekoninck E. A. and Culley S. J. (2009). Designing for 'use phase' energy losses of domestic products. *Proceedings of the Institution of Mechanical Engineers. Part B, Journal of Engineering Manufacture*, *223*(1), 115-120.
[7] Kuijer L. (2014). *Implications of social practice theory for sustainable design* Eindhoven University of Technology.
[8] Scott K., Bakker C. and Quist J. (2012). Designing change by living change. *Design Studies*, *33*(3), 279-297. https://doi.org/10.1016/j.destud.2011.08.002.
[9] Norman D. A. (2013). *The Design of Everyday Things* (Revised and Expanded Edition ed.). Basic Books.
[10] Srivastava J. and Shu L. (2013). Affordances and product design to support environmentally conscious behaviour. *Journal of Mechanical Design*, *135*(10), 101006. https://doi.org/10.1115/1.4025288.
[11] Gao Y., Song D., Liu L. and Huang Y. (2023). Nested affordance-based intuitive design tool: Affordance interaction matrix. *Cogent Engineering*, *10*(1), 2231723.
[12] Lu J. and Cheng L. (2013). Perceiving and Interacting Affordances: A New Model of Human–Affordance Interactions. *Integrative Psychological and Behavioural Science*, *47*(1), 142-155.
[13] Fukasawa N. (2014). *Naoto Fukasawa* (Y. Lu, Trans.). Zhejiang People's Publishing House.
[14] Eysenck M. W. and Brysbaert M. (2018). *Fundamentals of cognition*. Routledge.