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Design-led Intervention for Reducing Overrealiance on Food Delivery Services(FDS)

Design-led Intervention for sustainable behaviour

음식 배달 서비스 의존 감소를 위한 디자인 주도 행동 개입 연구

지속가능한 행동을 위한 디자인 주도 행동 개입

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Abstract

The COVID-19 pandemic boosted food delivery service (FDS) usage, causing unsustainable habits and environmental concerns. This study aims to develop a behavioural change intervention to promote sustainability-oriented motivations. The intervention involved the use of a bingo board to set and track goals for alternative behaviours. The intervention showed a reduction in FDS use frequency and an improvement in participants' sustainability awareness. The bingo board provided a sense of accomplishment and satisfaction, acting as reinforcement, while the bonus response cost served as both a reinforcement and a punishment. This study provides insights into the need for developing design-led interventions for promoting sustainable behaviours.

Keyword

food delivery service(음식 배달 서비스), behavioural change intervention design(행동 변화 개입 디자인), design-led intervention(디자인 주도 개입)

요약

COVID-19 대유행은 음식 배달 서비스(FDS) 이용 증가를 초래하였으며, 건강에 해로운 식습관 형성 및 지나친 포장 용기 사용으로 인한 환경 문제 등 지속가능하지 않은 행동 습관을 촉진하였다. 본 연구는 이에 대해 대체 행동 및 지속가능성 지향 동기를 촉진하기 위한 행동 변화 개입을 디자인하였다. 예비 조사를 통해 음식 배달 서비스에 대한 인식을 수집하고, 개입 대상 그룹을 식별하기 위해 페르소나를 생성하였다. 4명의 참가자와의 인터뷰를 통해 맞춤형 전략을 개발하였다. 행동 변화 개입 디자인은 대체 행동의 목표를 설정하고 추적하기 위해 빙고 게임을 차용하였으며, 강화와 보상을 제공하기 위해 보너스 반응 비용 체계를 도입하였다. 개입의 효과는 질적 및 양적 데이터를 통해 평가되었다. 개입은 FDS 사용 빈도의 감소와 참가자들의 지속가능성 인식의 향상을 보여주었다.

목차

1. Introduction

1-1. Background

As COVID-19 has spread worldwide since the start of the year 2020, there have been many changes in our society, most notably in our everyday ordinary lifestyle, such as diet. As a risk mitigation measure, consumers ceased dining in restaurants and opted to purchase and consume delivered food at home[1]. Despite the fact that social-distancing interactions have declined significantly, the frequency of food delivery service (FDS) usage has steadily increased, as has the expenditure due to its consequences[2]. The food industry, including restaurants, was badly impacted in a situation where social estrangement was fostered as a result of COVID-19, but on the other hand, the delivery service platforms were amplified, allowing the business to continue to operate. Serving our daily meals via FDS has now become a norm for many, which eliminates the labour of cooking , and people are accustomed to this convenient service of having food delivered straight from the restaurant to any venue they wish.

However, excessive FDS use may result in unforeseen adverse outcomes. Particularly, FDS-related awareness change has not been implemented in daily eating activities, such as grocery shopping, cooking, or dining at a local restaurant, as a significant method of empowering healthy eating awareness. Due to the fact that FDS promotes ordering a variety of foods regardless of meal time, it may foster irregular eating patterns or unhealthy food consumption, such as fast food[3]. The consequences of excessive use of FDS can significantly affect not only one individual level but also the socio-environmental level. Excessive usage of single-use plastic bags and containers for packing can also be environmentally unsustainable. Moreover, food delivery could release carbon dioxide because of delivery motorcycles that produce more emissions than other vehicles[4].

1-2. Research Question

This study focuses on developing behavioural change interventions that re-promote mundane everyday actions such as grocery shopping, cooking, and local dining that have been neglected as a consequence of excessive usage of Food Delivery Services. Therefore, the research question of the study is, "How might we reduce overreliance on Food Delivery Services (FDS) use through promoting alternative behaviours and sustainability-oriented motivations?"

[Table 1] Research Flow

	Research flow
1	behavioural change theories literature analysis
2	review existing interventions
3	preliminary survey
4	target group selection, persona design
5	participant interview
6	intervention strategy design
7	baseline pilot intervention (1 week)
8	intervention (2 weeks)
9	post- intervention (1 week), participant interview
10	intervention data analysis

1) Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., and Yannelis, C. How does household spending respond to an epidemic? Consumption during the 2020 COVID-19 pandemic. The Review of Asset Pricing Studies, vol. 10, no. 4, 2020, pp. 834-862.

2) Kim. D. "During the COVID-19 epidemic, the number of use of delivery apps nationwide increased by 29%" Hana Financial Management Research Institute. (2022.10.6.) http://www.bikorea.net/

3) Kim, M. H., and Yeon, J. Y. Changes in dietary life after COVID-19 among some college students in Chungcheong area, and the actual use of home convenience meals and delivered food. Journal of Nutrition and Health, vol. 54, no. 4, 2021, pp. 383-397.

4) National Environmental Education Center. To reduce carbon emissions, delivery food needs to change! (2022.10.10.) https://www.keep.go.kr

The flow of the study is shown in Table 1 above. Through a literature analysis of behavioural change theories, the present status and shortcomings of existing interventions as alternatives to FDS were examined. In order to develop a novel intervention based on the behavioural change theory, a preliminary survey was conducted to find out how individuals perceive issues related to FDS. The target group for the behavioural change intervention was determined, and personas were created. Finally, through interviews with 4 participants, an intervention was developed that provided a personalised strategy for each participant to instigate a behaviour change - reducing FDS use frequency. The qualitative and quantitative data were reviewed to assess if the participants' alternative behaviours were prompted and if their awareness of FDS usage has changed as a result of their new behavioural habits.

2. Literature Review

2-1. Behavioural change theories

To stimulate a behaviour change, we reviewed previous literature regarding behavioural change theories, specifically Applied Behaviour Analysis, Social Norm Theory, and Perceived Behaviour Control.

2-1-1. Applies Behaviour Analysis (ABA)

In applied behaviour analysis, the possibility of a specific behaviour happening in the future has to do with the prior circumstance that the behaviour happens and the consequence that the agent who does the behaviour experiences[5]. If the agent experiences reinforcement as a result of the behaviour, the person is more likely to do the same in similar situations. If, on the other hand, the agent is punished as a result of the behaviour, the agent's likelihood of repeating the same behaviour in similar situations in the future decreases.

In terms of reinforcement, the typology of reinforcer could be tangible or intangible, and the effect of reinforcer on the behaviour could be different depending on the schedule of reinforcement. Especially to make the agent do the targeted behaviour for the first time, it is crucial to give the reinforcer whenever the target behaviour occurs. However, it is also necessary to gradually loosen the reinforcement schedule to make the agent maintain the target behaviour pattern in natural situations.

The punisher could be both tangible and intangible, as the reinforcer is. Moreover, depending on how the punishment is being done, it could be classified as positive or negative punishment. Response cost is one example of negative punishment, and it is done by taking away something the agent likes or feels worthy enough when the one does the target behaviour. As a result of response cost, the subject is less likely to repeat the behaviour in similar situations.

2-1-2. Social Norm Theory

According to social norm theory, an individual expresses or inhibits certain behaviours to conform to the social norms the person perceives[6]. Social norms are defined as shared rules about desirable behaviours, values, and beliefs that the group accepts. Deutsch and Gerard[7] argued that it is important to

5) Cooper, J. O., Heron, T. E., and Heward, W. L. Applied behavior analysis, 2nd ed., Pearson Education, 2007.

6) Cialdini, R. B., Reno, R. R., and Kallgren, C. A. A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. Journal of personality and social psychology, vol. 58, no. 6, 1990, pp. 1015–1026.

7) Deutsch, M., and Gerard, H. B. A study of normative and informational social influence upon individual judgment. Journal of Abnormal and Social Psychology, vol. 51, 1955, pp. 629–636.

discriminate between descriptive and injunctive social norms since each refers to a separate source of human motivation. The descriptive norm describes what behaviour is typical in the group, such as the behaviour commonly displayed by most people in the group. On the other hand, the injunctive norm refers to what behaviour is approved or disapproved in the group and specifies what ought to be done. Therefore, there is a high possibility of an individual engaging in the target behaviour if the one perceives social norms by watching people in the social group doing the behaviour often or by recognizing what people in the social group approve and expect the one to do[8].

2-1-3. Perceived Behaviour Control (PBC)

According to Ajzen's Theory of Planned Behaviour, perceived behavioural control(PBC) is a key determinant of an individual's intention to engage in a behaviour, and the strength of that intention is influenced by available resources and opportunities[9]. Scholars from different disciplines have given diverse interpretations to PBC; for example, Wallston[10] defined it to be the level of ease or difficulty of performing a specific behaviour from a health behaviour perspective. Perceived affordance which has been defined by Norman[11], a design theorist, refers to the relationship between an object or interface's design and the actions that can be taken on it, which affects the ease or difficulty of performing a specific behaviour. Thus, the affordance of the behaviour can be hindered or enhanced by factors such as available resources and opportunities, and consumers' values and beliefs about these factors will also play a role[12]. However, whilst the notion of affordance mainly refers to a physical form of design that guides intended behaviour, the function of feedback and feedforward is widely utilised in design-led interventions; for example, an energy smart-meter showing energy usage to curve their overall consumption[13][14]. Feedback is a process of allowing users to learn the consequence of behaviour, but it also facilitates the formation of habit-building as they get reinformed by the provided behavioural information[15]. However, Shin and Bull[16] also emphasise the role of the feedback-forward, which allows users to receive predicted information about the changed behaviour. It often leads the user to select new actions that are based on the future scenario or speculation of arising benefit upon performing the intended behaviour. Hence, the PBC plays a

8) Cialdini, R. B., Reno, R. R., and Kallgren, C. A. A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. Journal of personality and social psychology, vol. 58, no. 6, 1990. pp. 1015– 1026

9) Ajzen, I. The theory of planned behavior. Organizational behavior and human decision processes, vol. 50, no. 2, 1991. pp. 179–211

10) Wallston, K. Control Beliefs: Health Perspectives. International Encyclopedia of the Social & Behavioral Sciences(Vol. 11), edited by N. J. Smelser and P. B. Baltes, Elsevier, 2001, pp. 2724–2726.

11) Norman, D. A. The way I see IT signifiers, not affordances. Interactions, vol. 15, no. 6, 2008, pp. 18–19.

12) Amin, A., Arefin, S., Alam, R., Ahammad, T., and Hoque, R. Using mobile food delivery applications during COVID–19 pandemic: An extended model of planned behavior. Journal of Food Products Marketing, vol. 27, no. 2, 2021, pp. 105–126.

13) Darby, S. The effectiveness of feedback on energy consumption. A Review for DEFRA of the Literature on Metering, Billing and direct Displays, 486. 2006.

14) Matsumura, N., and Fruchter, R. Shikake trigger categories. AAAI Spring Symposium Series. 2013.

15) Van Houwelingen, J. H., and Van Raaij, W. F. The effect of goal–setting and daily electronic feedback on in–home energy use. Journal of consumer research, vol. 16, no. 1, 1989, pp. 98–105.

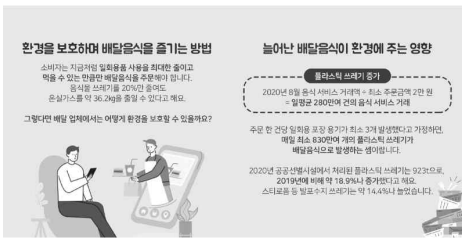
16) Shin, Hyunjae Daniel, and Richard Bull. "Three dimensions of design for sustainable behaviour." Sustainability 11.17. 2019.

critical role in any design-led intervention, which should facilitate a system that allows users to realise their behaviour consequence but also to reinforce their actions through information that stimulates attitude and motivation to sustain the changed behaviour.

Furthermore, perceived behaviour control is a major determinant in the intention to engage in healthy behaviour as well as subsequent behaviour[17)18)]. However, this is dependent on external factors such as past experiences, ability, needs, and convenience[19)]. Thus, greater knowledge and skills could lead to stronger behavioural intentions[20)]. For example, previous research has looked at the confidence that using delivery apps is the person's choice and that there is no obstacle to using delivery apps. In addition, it has previously been found that particularly past experiences have determined consumer intention in using food delivery services[21)]. Thus, positive and convenient experiences can increase consumers' intention to engage in the behaviour, while negative and difficult experiences may hinder it.

2-2. Existing Interventions

There have been several previous delivery reduction interventions within Korea. One intervention was from Baedal's Minjok, which is one of the most prominent Korean food delivery service applications. The intervention targeted the environmental concerns that arise from delivery service, mainly the increased use and disposal of single-use plastic. Thus, they created a separate category for restaurants that utilize multi-use containers[22)]. However, it required the restaurant's responsible involvement and was even difficult for users to access easily. This ease of access to restaurants participating in this program particularly hindered their perceived behavioural control. Additionally, in terms of applied behaviour analysis, there was a lack of reinforcement to encourage usage of this service that could promote future usage, and there were no social signifiers indicating that many people are using it or that this was the accepted behaviour[23)].



[Fig 1] Campaign distributed by the Ministry of Environment (2022)

Similar issues arose with government intervention in the form of card news campaign

17) Poon, W. C., and Tung, S. E. H. The rise of online food delivery culture during the COVID-19 pandemic: An analysis of intention and its associated risk. European Journal of Management and Business Economics. 2022.

18) Wallston, K. Control Beliefs: Health Perspectives. International Encyclopedia of the Social & Behavioral Sciences(Vol. 11), edited by N. J. Smelser and P. B. Baltes, Elsevier, 2001. pp. 2724-2726

19) Poon, W. C. Op. cit.

20) Amin, A., Arefin, S., Alam, R., Ahammad, T., and Hoque, R. Using mobile food delivery applications during COVID-19 pandemic: An extended model of planned behavior. Journal of Food Products Marketing, vol. 27, no. 2, 2021, pp. 105-126. DOI: 10.1080/10454446.2021.1906817.

21) Poon, W. C., and Tung, S. E. H. The rise of online food delivery culture during the COVID-19 pandemic: An analysis of intention and its associated risk. European Journal of Management and Business Economics. DOI: 10.1108/EJMBE-04-2021-0128.

22) Byeon, Y. Seoul Metropolitan Government launches 'Zero Restaurant' service. TV Seoul, 2022.8.29. (2022.10.10) http://www.tvseoul.kr/

23) Norman, D. A. The way I see IT signifiers, not affordances. Interactions, vol. 15, no. 6, 2008, pp. 18-19.

by the Korean Ministry of Environment. The campaign featured specific information about the negative impact of food delivery services on sustainability and alternative behaviours to try [24]. However, there were no cues as to whether such behaviour was considered a social norm, as well as no reinforcers to motivate the readers to engage in the behaviour, particularly for people who were not sustainability conscious. Moreover, although information could help with perceived behavioural control, access was limited, as it could only be found through specific keyword searches or by following the Ministry of Environment on Instagram.

3. Methodology

3-1. Preliminary Survey

An online preliminary survey was conducted to collect general and detailed information regarding people's food delivery service (FDS) experiences. From October 2nd, 2022 to October 8th, 2022, a week-long survey was distributed to researchers' extended networks of friends and families via text messages and emails. Participants responded to 35 questions on the online platform Typeform, concerning their experiences with FDS, their attempts to cease or reduce their usage and their awareness of sustainability related to FDS. The demographics of the participants of the survey are as follows.

[Table 2] Demographics of the participants

Variable	%
Gender (n=100)	female (61%) male (39%)
Age (n=100)	~20 (1%), 21~30 (81%), 31~39 (16%), 40~ (2%)
Living with (n=100)	alone (30%), family (62%), roommates (8%)
Number of household members (n=98)	1 (30.6%), 2 (13.3%), 3 (18.4), 4 (30.6%), 4+ (7.1%)

People are motivated to change their behaviour for personal reasons, despite the fact that the majority of them have experienced negative emotions due to environmental issues. About 70% have experienced negative emotions related to FDS and 50% think they should use less FDS. 37% of these people said that their need to use less FDS was related to both their health and their financial stability. 54.5% of the participants agreed that they have tried to stop/reduce FDS; however only 10% completely stopped using it. Even though they have failed to stop or reduce FDS usage, 56.6% of the participants had the willingness to stop or reduce FDS, and 58.6% of them wishes to limit its use only on special occasions. Regarding the impact of FDS use, the participants showed concerns related to eating unhealthy food(53%), overeating(54%), being less active(47%), consumeing more night snacks(41%), and spending more money(71%). The result implies that the participants are undergoing experiences far from sustainable life.

3-2. Target group and Persona

Based on the survey findings, our target audience was narrowed to individuals who have experienced difficulty in changing their behaviour, but still desire to reduce their FDS consumption patterns. Given that the majority of the targets are aware of sustainability issues and are willing to reduce their FDS usage frequency, this study focuses on internalizing motivation from extrinsic sources, rather than being motivated by external

24) National Environmental Education Center. To reduce carbon emissions, delivery food needs to change.(2022.10.10.) https://www.keep.go.kr/

factors. Of the 31 participants, they felt the need to use FDS less often, had attempted to do so in the past, and were willing to make a change in the future. On average, more than half of the 31 participants used FDS between 1 and 5 times per month. Two-thirds of respondents indicated that they would only use FDS for special occasions. 12 individuals deleted the FDS app and completely stopped using it, 11 individuals have attempted to cook more often, and 3 individuals attempted to use pick up options or eat out. Despite these efforts, they have failed in the past due to difficulties in the process of preparing the meal. From Perceived Behaviour Control perspective, FDS offers much convenience opportunities which in turn make individuals feel difficult to change their behaviour. Significant number of people mentioned that they would like to try the same method again, such as 18 people who mentioned cooking and 12 people who mentioned food pickup service. Of the 100 respondents, a total of 26 people expressed their intention to participate in the follow-up intervention. Among them, we attempted to recruit participants to form a focus group particularly with those who have previously failed to change behaviour and use FDS more than six times per month. A total of 6 participants were recruited for the focus group and they are listed in Table 3.

[Table 3] Characteristics of focus group

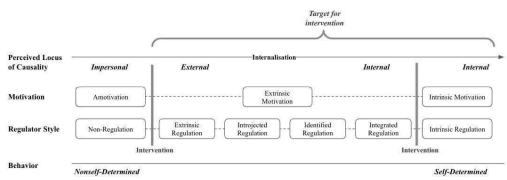
participant	A	B	C
Gender	Male	Female	Male
Age	27	26	33
Current usage (times/month)	6-10	11-15	6-10
Goal usage (times/month)	1-2	only special occasion	only special occasion
Previous strategy (that failed)	Resist	Cook	Delete App
Preferred alternative strategy	Cook	Cook	Pick up
Motivation	N/A	Environmental, Health	Financial, Health
Sustainability awareness	Financial, Lifestyle	Environmental, Lifestyle	Environmental, Lifestyle

participant	D	E	F
Gender	Female	Female	Male
Age	24	31	20
Current usage (times/month)	11-15	6-10	11-15
Goal usage (times/month)	only special occasion	only special occasion	3-4
Previous strategy (that failed)	Delete App	Pick up	Dine out
Preferred alternative strategy	Pick up	Pick up	Pick up & Cook
Motivation	Financial, Health	Environmental,	Financial, Health
Sustainability awareness	Environmental, Lifestyle, Financial	Environmental, Lifestyle,	N/A

According to the self-determination theory[25],

25) Deci, E. L., and Ryan, R. M. Self-determination theory. Handbook of theories of social psychology, edited by P. A.

the internalisation of motivation for a behaviour is a gradual process that moves from amotivation to external motivation and eventually towards internal motivation. They hypothesised that extrinsic motivation can be controlled invariably to the extent to which they are self-determined as they enact the regulation, known as 'internalisation'. Figure 1 below illustrates this progression. When an individual shows a lack of desire to change behaviour, it can be controlled by either external (by others) or introjected regulation (individual). In contrast, identified and integrated regulation refers to individuals feeling strong ownership of behaviour, thus being more autonomous. There are two intervention points along the motivation spectrum, between amotivation and external motivation and between external motivation and internal motivation. In this study, our goal is to instigate a behaviour change so that the invalid can reach the latter point where individuals are motivated extrinsically, but not yet intrinsically - integrated regulation. By providing targeted intervention to individuals who want to reduce their use of FDS but face difficulties, we aim to lead them towards internalizing their motivation for the intended behaviour. Through cues and the physical environment set during the intervention, participants can internalize their motivation and self-regulate their behaviour.



[Fig 2] Motivation for behaviour and target group (redrawn from Deci & Ryan, 2000)

Based on the information collected by the preliminary survey, we developed 2 personas for different age groups, living conditions, careers, and aspects regarding the usage of the FDS. The personas were constructed to elaborate the target of the intervention program, and the detailed personas depicted are shown in Figure 2. Both of the personas reflect their consciousness and willingness to reduce their FDS usage. However, one is motivated by health benefits and wants to try cooking as an alternative, while the other persona focuses more on the financial benefit and wants to try pick-up to substitute FDS. Different goals, interests, and pain points for each persona implies that personalisation should be considered since people show similar behavioural patterns while they have inconsistent environmental factors to maintain and different motivation to reduce the use of FDS.

[Fig 3] Personas

3-3. Participants

The intervention was designed to offer a tailored format that takes into account each participant's lifestyle, desire for alternative meal plans, physical environment, and preparation condition. The key concept to internalize their motivation to reduce excessive dependency on FDS is giving personalized cues, information and specific directions to foster sustainability-oriented motivation. Thus, for each intervention participant, a personalised format of giving the information about guidelines to pick-up or purchase meal-kits and recipes to cook, was determined. Since the participants were already aware of the necessity of reduction in FDS, giving specific step-by-step guidelines could

M. Van Lange et al., Sage Publications Ltd., 2012, pp. 416-436.

increase the possibility of changing their behaviour and allow them to visually monitor their progress of behaviour change. Participants of the focus group who were willing to participate in the program were recruited. Table 4 shows their characteristics of motivational attitude towards intended behaviour change.

[Table 4] Individual characteristics of participants

	Stimulation	Context	Maintenance
	Belief Self-efficacy Expectations Intentions	Social support Barriers Opportunities Rewards Penalty	Skills Knowledge Habits
A	spending less, easy recipe convenience alarm at 5:30pm	rewards for walking (pick up)	healthy food info
B	weekly plan for cooking alarm at 6pm	in-person grocery shopping, rewards for cooking, corona situation	environmental & health benefits info
C	saving money alarm at 12pm	discount for pick up, short distance to pick up,	restaurant & kitchen info
D	reduce food waste alarm at 11am	freedom to choose menu, weekend,	good cooking skills

3-4. Theoretical Framework

The theories adopted for designing the intervention were Applied Behaviour Analysis(ABA), Perceived behavioural control(PBC), and Social norm theory(SNT). The strategies were condensed and represented visually through bingo game format, and we also intended to provide personalized feedback and feed-forward information to strengthen their intrinsic motivation, as well as elaborating on strategies scripted on intervention to stimulate a reinforcement. The applied strategies and linked theories are explained below in Table 5. Further explanation for the strategies will be provided in the next section.

[Table 5] Individual characteristics of participants

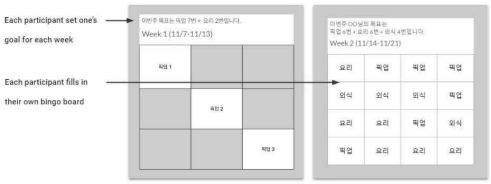
Theory	Context + Applied Strategy
ABA + PBC	Goal Setting for Alternative behaviour - Differential reinforcement for alternative behaviour - Setting goals for alternative behaviours based on their lifestyle - Perceived affordance
	Weekly Feedback Card - Feedback about the detailed effect of each participant's alternative behaviour in terms of sustainability
ABA	Row completion - Utilizing bingo to give sense of accomplishment
	Instant+Delayed reward (cariable Ratio Schedule) - 1000 won for every bingo - Coupons for completing the row first or the most rows in the group
	Bonus response cost - Deducting bingo if a participant delivers food from the number of bingos on the last day of the week.
PBC	Alarm notification - Feedforward by utilizing reminders and signifiers to guide possible actions
	Sustainability visual cards - Feedforward to encourage actions for sustainability
	Providing information - Providing recipes and list of restaurants to enhance the perception of ease and encourage alternative behaviours
PBC + SNT	Group chat - Bingo facilitated through group chat
	Social norm - Players with similar interest and background
	Equal chance & rules - Chances to earn benefit given equally

4. Intervention Design

4-1. Bingo

One of the main aspects of the intervention is to encourage the participants to do the alternatives more often so that the food delivery ordering behaviour frequency could be decreased. Increasing the frequency of the

alternative behaviour to decrease the frequency of the target behaviour is called differential reinforcement of alternative behaviour(DRA). The concept of DRA is derived from Applied behaviour analysis(ABA). The participants set goals for the frequency of alternative behaviour instead of ordering delivery, based on their lifestyle. This could also be explained as perceived affordance due to the fact that the users could visually capture how many times they have performed the new behaviour to achieve their own goal.

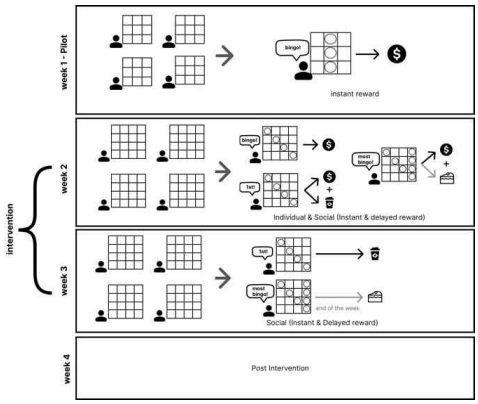


[Fig 4] Bingo board (left: 3x3 bingo board, right : 4x4 bingo board)

Bingo is used as a method to set and track goals. Bingo can provide a sense of accomplishment and satisfaction, which acts as reinforcement, when a row is completed. Furthermore, bingo increases the possibility of behaviour occurrence by earning reinforcers in a variable ratio schedule for behaviour maintenanc e[26]. A variable ratio schedule could be demonstrated as providing reinforcers in random schedules instead of constantly giving them every single time. Three types of rewards were designed : 1) 1000 won for completing a bingo row, 2) a coupon for completing the first row in the group (instant reward), and 3)coupons for completing the most rows in a group(delayed reward). Additionally, the frequency of food delivery service usage is subtracted from the weekly bingo total. We called this a bonus response cost, which serves as both a reinforcement and a punishment by deducting from the participant's weekly earnings.

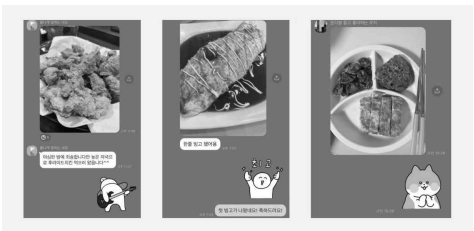
The main element of the intervention was conveyed through the bingo board. The overall flow of the bingo is shown in Figure 4. In the first week, a pilot run-through was conducted to introduce the participants to the intervention program and familiarize them with the rules. Each participant was given a 3x3 bingo board, with each square containing a random mission personalized to their goal(cooking and pick-up). Every time a bingo row was completed, the participant received 1000 won as an instant reward. In the second week, the bingo board given to each participant was expanded to 4x4, and dining out was included as one of the alternative behaviours. Each participant set their goals more specifically than they had in the first week, filling in their own bingo board according to the number of alternative behaviours they had planned. In addition to completing a bingo for individual rewards, they also participated in a competitive mission where the first participant to complete a bingo the fastest would receive a coffee coupon instantly. At the end of the week, the participant with the most bingo rows accumulated received a coupon for coffee and cake as a reward, while the bingo deduction was counted on the last day of the week. Moreover, all the participants entered the group chat and uploaded their photos on bingo board. Figure 5 below shows the screenshots of the contents they have shared in the group chat.

26) Collins, T. A., Hawkins, R. O., Flowers, E. M., Kalra, H. D., Richard, J., and Haas, L. E. Behavior bingo: The effects of a culturally relevant group contingency intervention for students with EBD. Psychology in the Schools, vol. 55, no. 1, 2018.



[Fig 5] Flow of bingo intervention

During the final week of the intervention program, the participants participated solely in a competition component. The competition required participants to quickly complete a bingo row, for which they would receive an immediate reward. In addition, the participant who had completed the most bingo rows by the end of the week would receive an additional reward. After the completion of the intervention, the bingo board and all related rewards were removed. One week later, individual interviews were conducted with each participant to assess if their altered behaviours were sustained and to grasp the overall effect of the intervention on their motivation towards reducing FDS.



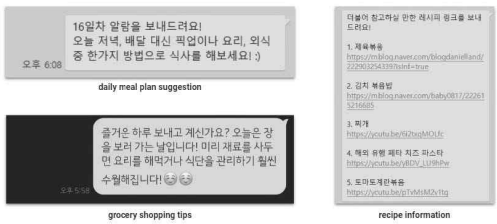
[Fig 6] Group chat of bingo intervention

4-2. Provision of personalized cues

During the intervention period, we also included additional intervention elements, besides bingo, in order to support the intervention effect on participants' behaviour change, for example providing information related with sustainability of FDS.

4-2-1. Alarm notification

For each participant, a personalised information and guidelines were provided everyday. An alarm notification could guide new actions by giving feedforward information. The alarm notifications given by Kakaotalk at the time that each participant preferred are shown in Figure 6. Suggestions on daily meal plans, grocery shopping tips, and recipe information to ease the difficulties of cooking were delivered to reinforce their behaviour change.



[Fig 7] Alarm notification

4-2-2. Sustainability as feedforward information

The sustainability visual cards were provided as a feedforward to encourage actions for sustainability. Three characters represented each aspect of sustainability, which could be influenced by FDS use. The earth character represents environmental sustainability, the wallet stands for financial sustainability, and the person symbolizes a sustainable lifestyle. The messages encouraged the participants to perform alternative behaviours such as picking up, cooking, or dining out to contribute towards sustainability. For example, "How about cooking or picking up today! You can lessen the gas emitted by the motorbike for delivery!" is one of the messages given. The sustainability visual cards were given every other day.

[Fig 8] Sustainability visual cards

Personalized weekly feedback was also given to the participants in terms of sustainability about the detailed positive effect of each participant's alternative behaviour. The positive effect of each participant's alternative behaviour was given according to the information on the environmental, financial, and health-related impact of FDS. The detailed information was calculated by multiplying the number of alternative behaviours on how much CO2 or delivery fee could be saved by trying alternative behaviours or how many times they went out for a short walk to pick up or to go shopping.

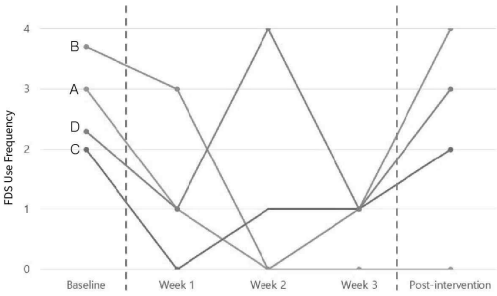
[Fig 9] Weekly feedback cards

5. Impact of Intervention

5-1. Food delivery use frequency

Changes in FDS use patterns for each participant are shown in Figure 9. Based on previous FDS use frequency, three of the participants (B, C, and D) used FDS less frequently during the intervention period. Participant A appeared to be FDS-free during weeks 2 and 3 of the intervention, as well as the post-intervention period; moreover, self-reports indicate that the habit persisted at post-intervention. Although Participant D's frequency of FDS use increased during the second week of intervention, the average frequency of FDS use during all three weeks of intervention was 1.67, which was lower than the baseline data of 2.33 per week. Participant D stated that if the duration of the intervention program had been slightly longer, the habit would have been more likely to persist after the intervention ended. Regarding the maintenance of behavioural change, Participant C's FDS frequency during the post-intervention period was the same as his baseline data, whereas Participants B and D used FDS more frequently during the post-intervention period than they did during the baseline period. Nevertheless, Participant B reported that the practice of picking up drinks continued.

To interpret the result from the perspective of ABA, the intervention design in this research refers to the A-B-A research design. A-B-A design is composed of 3 steps: measuring the baseline data (A), introducing the intervention to the participant (B), and withdrawing the intervention (A). According to the A-B-A research design, the fact that behavioural change occurs when the intervention is introduced, and the behaviour change reverts to the behavioural pattern similar to the original baseline state when the intervention is removed confirms that the intervention is effective. The results of FDS frequency change can be interpreted as participants formed intrinsic motivation during the intervention, and it helped them to use FDS less even after the intervention.

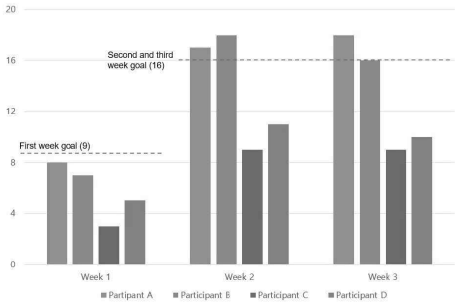


[Fig 10] Participants' FDS use frequency change patterns

5-2. Alternative behaviours

Figure 10 displays the number of alternative behaviours performed by each participant as a substitution for FDS usage, including ordering takeout, cooking, or dining out, during the 3-week intervention period. The initial goal for performing alternative behaviours in the first week was set at nine, but none of the participants achieved it. Participants A and B came close to success, with eight and seven instances respectively. The goal for alternative behaviour was increased to 16 in both the second and third weeks of the intervention. Participants A and B consistently exceeded the set goals by performing alternative behaviours more often in weeks 2 and 3. Conversely, Participants C and D showed lower levels of participation in alternative behaviours compared to Participants A and B throughout the intervention period. However, both Participants C and D showed a slight increase in alternative behaviour during the last two weeks compared to the first week.

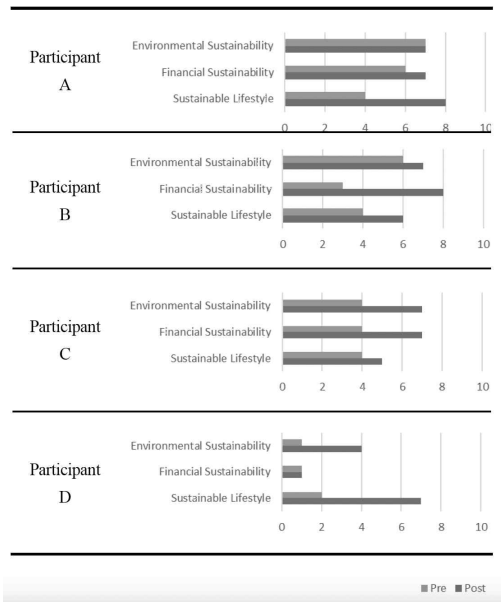
Throughout the intervention program, participants discovered and developed individualized strategies for their daily routines, resulting in a gradual increase in alternative behaviour. Participant A began to plan meals in advance based on his schedule or circumstances. Participant D began to implement her own method for dividing alternatively prepared meals into multiple portions. In the case of Participant C, meal planning began by looking at the pick-up menu in the FDS application. The intervention program stimulated intrinsic motivation to the extent that positive changes occurred while individuals independently pursued alternative behaviours. Participant A developed a positive attitude as a result of a unique experience through alternative behaviour. Participants B and C similarly realized that practising pick-up was more manageable than they had anticipated and adapted accordingly. Participant D developed a healthier eating mindset to be her priority value.



[Fig 11] Participants' alternative behaviour during intervention

5-3. Behaviour change for sustainability

Each participant answered on 1(not at all) to 10(totally matches), about how their behaviours regarding FDS use matched with three aspects of sustainability, including environmental sustainability, financial sustainability and sustainable lifestyle, before and after the intervention. The results are shown in Figure 12.



[Fig 12] Participants& behaviour change towards sustainability

First of all, Participant A reported the most significant change in terms of sustainable lifestyle. Financial sustainability also increased slightly. Although the behaviour towards environmental sustainability did not increase, its pre-intervention point was already relatively high, which was 7 and was maintained. In the case of Participant D, the point on sustainable lifestyle increased the most, from 2 to 7. However, she still reported her behaviour did not match much in terms of sustainability, which was the same point, 2, before and after the intervention. Both participants B and C reported their behaviours got more aligned with three terms of sustainability overall, compared to behaviours before the intervention. More specifically, Participant B showed the most significant change in financial sustainability, which increased from 3 to 8. Participant C reported a similar increase in both environmental and financial sustainability, from 4 to 7.

According to these scales, the change in value that participants felt most strongly about was environmental sustainability. Participants believed that alternative behaviours significantly reduced single-use waste. During the intervention period, Participant C reported reducing his use of disposable packaging because he ordered a moderate amount of food for pickup. Previously, he ordered too much food to meet the minimum order requirement. The participants did not order large quantities of food in order to satisfy the delivery conditions; instead, they regulated the amount of food for each individual, which led to healthy eating habits. Participant B noted that her diet was significantly healthier once she began preparing and selecting components for her meals. All of the participants saved a substantial amount of money because they were not required to pay the FDS delivery fee. This has enabled the formation of a habit of self-directed meal-related expenditures. In addition, participants A, B, and D reported that by being proactive rather than making deliveries, they had time to walk even briefly throughout the day, which contributed to a healthier lifestyle. Thus, the increased sustainability scores showed that participant's PBC was also higher, particularly as these actions became regulated and they became more accessible for them to carry out based on their past experiences. Presumably, referring back to the theories of behavioural change, the regulation within this process can be realised in which the function of feedback and forward confronts them with the consequences of their actions.

5-4. Bingo as intervention strategy

Several insights arose through the application of bingo as an intervention strategy. Particularly, through the bingo intervention, there were several emotions experienced by participants. Participants wanted to do their best and had fun finding good restaurants. Their attitude towards pick-up also positively changed as they considered it as less of a hassle. Furthermore, the bingo strategy instilled a competitive spirit within the participants. In addition, they felt

more responsibility, such as when ordering delivery with others, they would hesitate to agree. Out of the deployed intervention strategies, there were some that were found to be particularly effective in encouraging behavioural change. Firstly, the chat room that connects participants with each other was successful in delivering the principles and impacts of the social norm theory. Using the chatroom, participants were able to interact and talk with each other, share their progress, engage in competitive behaviour, and feel a sense of belonging, which leads to encouragement as it feels easier to do it together than alone. Moreover, the chatroom also reflects a sense of fairness by applying the same rules for all participants, gives support by providing feedback and encouragement using the chatbot messages character stickers, and gives inspiration and motivation by letting the participants see other people's alternative actions, take and share pictures, and observe how the other participants are doing. Furthermore, the participants found the execution of the bingo system to be effective as they could comfortably utilize the bingo board by crossing out the goals on the bingo board and creating the bingo, which would be exchanged with rewards. The distribution of the instant and delayed weekly rewards was also evaluated highly by the participants. In addition to the feedback provided, the feedforward in the form of an alarm/reminder was also perceived to be effective by the participants. The frequency of alarm or reminder may have varying impacts; however, participants went through the learning process where provided information (feedback and forward) challenged their previous choices, and they adjusted themselves to exercise a different choice in future actions. This, in turn, can help the individual self-regulate their newly established behaviour. The messages, scheduled reminders, and alarms were compelling and useful in encouraging alternative behaviour. Overall, the intervention strategies were generally perceived well by the participants; particularly, the inclusion of pick-up and eating out as alternative behaviours made it more feasible for the participants to complete the goals. Also, the impact of the participants and the program itself positively influenced the participants. The impression of having someone observing one's behaviour over the course of three weeks formed a habitual routine, which is further fortified by being put in a situation that resembles fulfilling a promise made to someone.

However, participants also felt some aspects needed to be improved. For example, they mentioned that when they were busy but kept receiving notifications, they felt uncomfortable or that they would prefer if the bingo board was randomly generated as opposed to self-made. In addition, the criteria for completion of alternative behaviour were sometimes ambiguous, and the alarm for grocery shopping did not have much meaning. Particularly, since the bingo game was played through KakaoTalk chat and manually coordinated by researchers, the need for systematic improvements was posed. As for the bingo effects on the participants, some participants felt negative emotions when they lost, and they felt they were tied down by the intervention. For example, after the intervention ended, they felt liberated. Furthermore, they found the rules to achieve bingo as burdensome, specifically the pressure that came with reporting. This included reporting every time they achieved a bingo, the burden of achieving bingo or forgetting to post pictures, the burden of sharing pictures with others, difficulty in providing proof, and the actual activity of taking and sending pictures. They would also perform the behaviours just for bingo as opposed to being intrinsically motivated.

6. Conclusion & Limitations

This study aimed to find out the effective way to reduce FDS usage frequency through a design-led intervention that promotes alternative

behaviours and sustainability-oriented motivations. For this purpose, an intervention through bingo was designed based on three behavioural change theories: applied behaviour analysis, social norm theory and perceived behaviour control. The intervention was conducted on four participants, and both quantitative and qualitative data were collected in order to verify the effectiveness of the intervention and to identify the pros and cons of the intervention. During the intervention period, all the participants were prompted to do alternative behaviours such as cooking, pick-up, or dining out, and it led to lowered FDS use frequency in all participants. Moreover, the participants reported that they had the opportunity to realize the easiness of alternative behaviours and that their behaviour overall became more aligned with sustainability through the intervention. Participating in bingo through group chat allowed the participants not only to enjoy the intervention but also to be aware of alternative behaviours instead of using FDS by watching others doing it.

The limitations of this study are as follows. First, circumstances requiring FDS in today's fast-paced society were not considered. Although FDS is a useful tool, this intervention program, which was solely focused on promoting alternative behaviours, was unable to provide tolerance for using FDS properly when participants were busy, when the weather was bad, or when they craved a specific food delivered. Second, a significant limitation of studies is the limited intervention period due to a lack of research funding. While the average time for empowered behaviour change to become a habit is 66 days[27], the program in this study was carried out for 21 days duration with the baseline measurement period included. To enhance the robustness of findings, it is recommended that subsequent studies expand their research duration beyond the minimum required to comprehend the intricate processes via which stimuli influence the maintenance of changed behaviours. For instance, it would be valuable to explore the manner in which incentives are administered and by whom. Furthermore, the present study has employed the Bingo game as an intervention strategy, successfully implementing its intended functions within the proposed theoretical framework. However, it is recommended for future research to conduct a pilot or preliminary study in order to discover the most successful design intervention technique before implementing it in the main study. This might potentially be achieved through the use of a longitudinal study.

Regarding the impact on related design research, this study highlights the potential of incorporating behaviour theory into design-led interventions, which can be applied to address various issues such as obesity, addiction, and media control. Although a single intervention startegy (Bingo) was used in this study, the method of adopting theories into design intervention we employed in this study should be taken as a key contribution to the field. An outcome that we note is how the role of design can support in the context of behavioural change. As a follow-up, a gradual reduction of rewards over a more extended period could be implemented to increase the likelihood of sustained behaviour change according to the principles of ABA. This can be achieved through an A-B-A-B experimental design where the intervention is withdrawn and re-implemented. However, it should be noted that the results of this study may not necessarily be applicable to other age groups or households with multiple members, and additional verification through follow-up studies is required to generalizse the effectiveness of the intervention program for participants with diverse characteristics.

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