Distinct Characteristics between "Anshin" and Feeling of Safety Evaluations

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***Abstract*—In Japan, there is a well-known idiomatic expression called "anshin anzen." Generally, "anshin" is defined as "subjective peace" and "anzen" as "objective safety." However, previous studies have shown that objective safety, which is determined by physical measurements, does not always match the subjective feeling of safety. How does the feeling of safety differ from "anshin," which is inherently subjective? In this study, participants were asked to evaluate "anshin" or feeling of safety for automobile features, and the two evaluations were compared. The results showed that both evaluations decreased in response to high malfunction rates, but the feeling of safety evaluations did not decrease for the high criticality features. Additionally, both evaluations increased for moderate or low malfunction rates, but the feeling of safety evaluations did not increase for low criticality features. These findings indicate that the feeling of safety is sensitive to feature criticality and information.**

Keywords-component; anshin; anzen; subjective evaluation.

I. Introduction

A. Concept of "Anshin and Anzen"

In the Japanese language, there is a well-known idiomatic expression called "anshin anzen." "Anshin" is translated as "peace of mind and freedom from care [anxiety]" and "anzen" as "safety, security, and freedom from danger" [1]. Although these two are often used together, there are subtle differences in their meanings. "Anshin" has unique nuances that cannot be translated into English accurately [2]. Hereafter, "anshin" is used as it is although "anzen" is replaced with "safety".

Actually, the terms "anshin" and "anzen" are used differently. For example, "koutsu anzen (traffic [road] safety)", "anzen unten (safe driving)", and "anzen kijun (safety standards)" are listed in the Japanese dictionary; however, "koutsu anshin (traffic [road] peace)", "anshin unten (peaceful driving)", or "anshin kijun (peace standards)" are not listed [1].

According to the Japanese definitions, "anshin" is subjective and safety is objective. "Anshin" is a subjective feeling based on psychological factors. There are no definite steps to evoke "anshin," whereas safety can be ensured with technology [3]; "anshin" varies significantly from person to person and is strongly dependent on trust whereas safety evaluation requires an objective and quantitative approach [4]. "Anshin" is the belief that the situation is not very different from what one expects and that one can accept a sudden unexpected mishap. In contrast, safety is objectively defined as the absence of damage to individuals and communities [5].

B. "Anzen-kan" (Feeling of Safety)

In recent years in traffic studies, subjective evaluations from drivers or pedestrians have become important. Studies have focused on aspects, such as risk perception [6]–[8], comfort/discomfort [9]–[12], and fear [11].

Objective safety, which is determined based on physical measurements such as speed and gap between two vehicles, does not always match subjective evaluations [13]. For example, passengers in an automated vehicle perceive risk even when the vehicle maintains an objectively safe speed and gap [8]. A model was built to estimate risk perception of pedestrians based on physical measurements [13].

Thus, it is important to verify how people perceive objective safety subjectively. The feeling of safety is apparently the same as the subjective "anshin", but with some subtle differences. The term "safety" is mostly used in the context of nuclear power and disasters while "anshin" is mainly used for life and economy; thus, the two terms are clearly used differently in Japan. It is predicted that feeling of safety evaluation will be lower than "anshin" evaluation for machinery posing a high risk to human life because the objective criteria would be stringent. Therefore, the first goal of this study is to verify the differences between "anshin" and feeling of safety evaluations for automobile features with different levels of criticality.

Subjective evaluations of automobile features are affected by information about their performance, that is, how they function. Drivers' subjective evaluations change in response to information regarding Adaptive Cruise Control (ACC); these evaluations change further when they practically use of ACC [14]. Thus, information indicating functional instability may affect "anshin" and feeling of safety evaluations, especially when the feature is critical. Therefore, the second goal of

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this study is to verify how "anshin" and feeling of safety evaluations change before and after the provision of information regarding the unstable performance of automobile features having varying levels of safety criticality.

Section 2 describes the experimental method and Section 3 describes the results of the experiment. In Section 4, we discuss the differences between "anshin" and feeling of safety evaluations.

II. METHOD

A. Experimental Design

The following four factors were manipulated in the experiment: Evaluation ("Anshin"/Feeling of Safety; between-participant factor); Malfunction (MHigh/MMid/MLow; between-participant factor); Criticality (CHigh/CMid/CLow; within-participant factor); and Phase (Pre-evaluation/Post-evaluation; within-participant factor). The Evaluation factor is set as a between-participant factor to prevent confusion between "anshin" and safety. The Malfunction factor was also set as a between-participant factor to prevent direct effects of values of malfunction rates.

B. Participant

We recruited 270 participants using a crowdsourcing service and randomly assigned each participant to one of six conditions. Due to incomplete questionnaires, 29 participants were excluded. Thus, 241 participants were included in the analysis (Table I; $M_{age} = 40.96, SD_{age} = 8.77$).

TABLE I
DISTRIBUTION OF PARTICIPANTS

	MHigh[1]	MMid[1]	MLow[1]
"Anshin" Evaluation	37	37	42
Feeling of Safety Evalulation	40	43	42

[1] MHigh = Malfunction High, MMid = Malfunction Mid, MLow = Malfunction Low.

C. Procedure

All the procedures were conducted on a browser, and informed consent was obtained in advance. First, participants were asked to respond freely to the question: "What do you think about 'anshin'?" in the "anshin" conditions or "What do you think about safety?" in the feeling of safety conditions to improve the validity of the subsequent evaluations. Next, the automobile feature to be evaluated was presented. For example, a question in the anshin-CHigh condition was as follows: "In recent years, the automatic driving feature has become popular. This feature allows a vehicle to sense its surroundings and automatically drive to the destination. Although this feature is effective in reducing drivers' efforts, malfunctions can still occur. What do you feel about its 'anshin'?" Participants were asked to respond using a 7-point scale (Pre-evaluation).

Subsequently, as a report, a total of six malfunction rates measured for three regions by two companies were presented. The six malfunction rates were approximately 2% in the MHigh conditions, 0.02% in the MMid conditions, and 0.0002% in the MLow conditions on average. Participants responded to the same question as in the pre-evaluation considering the malfunction rates (Post-evaluation).

Similarly, participants responded to questions about the automobile features in CMid and CLow conditions, which were automatic parking and automatic wipers, respectively. The order of three safety criticality conditions was counterbalanced among participants.

III. RESULTS

A. Pre-Evaluations

In order to verify the differences between "anshin" and feeling of safety evaluations of automobile features varying in safety criticality, Evaluation $\times$ Criticality ANOVA was conducted in the pre-evaluation (Figure 1). The results showed that the main effect of Evaluation was significant ($F(1, 239) = 23.78,\ p < .001,\ \eta_p = .09$), and feeling of safety evaluation was higher than the "anshin" evaluation. The main effect of Criticality was also significant ($F(2, 478) = 165.66,\ p < .001,\ \eta_p = .40$), and further analysis showed that the evaluations were higher for CHigh, CMid, and CLow in that order (ts $> 7.43,\ p$s $< .001$). However, the interaction was not significant ($F(2, 478) = 0.30,\ p < .001,\ \eta_p = .09$). Thus, although the feeling of safety evaluation was higher than the "anshin" evaluation in pre-evaluation, there was no difference between "anshin" and feeling of safety with respect to the safety criticality of the automobile features.

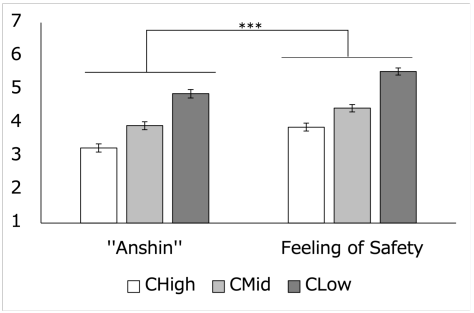

Figure 1. Pre-evaluation. Error bars represent standard errors. CHigh = Criticality High, CMid = Criticality Mid, CLow = Criticality Low. $***p < .001$.

B. Changes due to Information

To verify the differences in changes in "anshin" and feeling of safety evaluations before and after the provision of information regarding the unstable performance of features varying in safety criticality, Malfunction $\times$ Criticality $\times$ Phase ANOVAs were conducted in the two evaluations (Figure 2). The common and distinct characteristics are separately reported below.

1) Common Characteristics: The main effects of Criticality were significant in both "anshin" and feeling of safety evaluations and further analysis showed that the evaluations were higher for CLow, CMid, and CHigh in that order ("anshin": ts $> 5.54,\ p$s $< .001$; feeling of safety: ts $> 5.54,\ p$s $< .001$). Malfunction $\times$ Phase interactions were significant, and the simple main effects were significant in MHigh, MMid, and

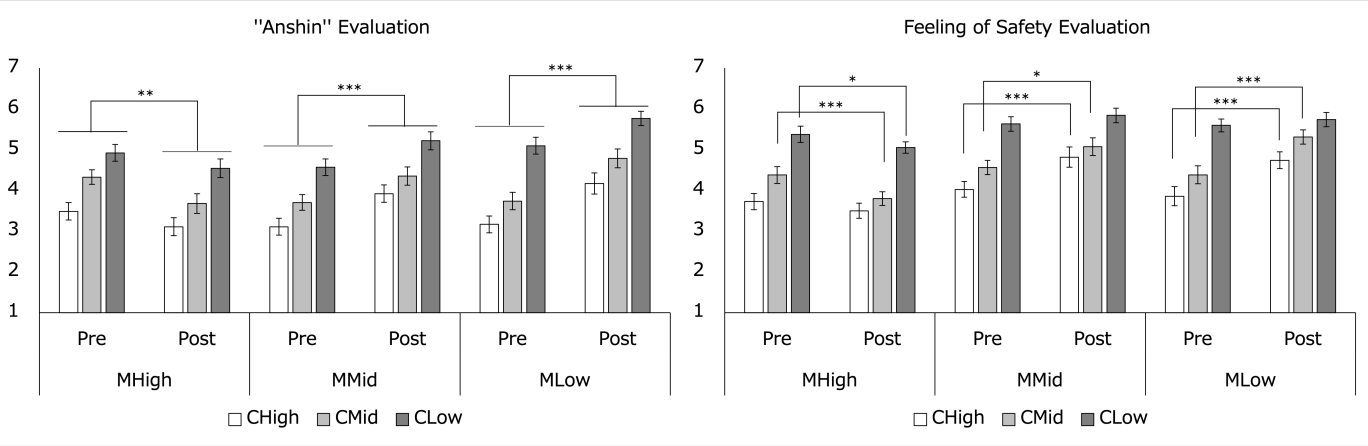

Figure 2. Evaluations in "anshin" and feeling of safety conditions. Error bars represent standard errors. MHigh = Malfunction High, MMid = Malfunction Mid, MLow = Malfunction Low, CHigh = Criticality High, CMid = Criticality Mid, CLow = Criticality Low. $*p < .05$, $**p < .01$, $***p < .001$.

TABLE II
RESULTS OF ANOVAS IN "ANSHIN" AND FEELING OF SAFETY CONDITIONS

	"Anshin"					Feeling of Safety				
	df	F	p		η_p	df	F	p		η_p
Malfunction	$2, 113$	2.23	.111	***	.03	$2, 122$	6.79	.001	**	.10
Criticality	$2, 226$	82.97	$< .001$	***	.42	$2, 244$	114.97	$< .001$	***	.48
Phase	$1, 113$	19.54	$< .001$	***	.14	$1, 122$	9.47	.002	**	.07
Malfunction × Criticality	$4, 226$	0.82	.510		.01	$4, 244$	0.62	.641		.01
Malfunction × Phase	$2, 113$	23.63	$< .001$	***	.30	$2, 122$	14.09	$< .001$	***	.18
Criticality × Phase	$2, 226$	0.05	.350		.00	$2, 244$	9.95	$< .001$	***	.07
Malfunction × Criticality × Phase	$4, 226$	1.28	.275		.02	$4, 244$	4.07	.003	**	.06

$**p < .01$, $***p < .001$.

MLow conditions ("anshin": Fs > 8.57, ps $< .006$, η_ps $> .19$; feeling of safety: Fs > 9.56, ps $< .004, \eta_p$s $> .19$). Specifically, the pre-evaluations were higher in the MHigh condition and the post-evaluations were higher in the MMid and MLow conditions. Thus, both of "anshin" and feeling of safety evaluations decreased with high malfunction rates, but increased with moderate or low malfunction rates.

2) Distinct Characteristics: Because the second-order interaction of Malfunction × Criticality × Phase was significant only in the feeling of safety condition, further analysis was conducted (Table III). The results showed that the decreases due to high malfunction rates were not found in the CHigh condition. On the other hand, the increases due to moderate or low malfunction rates were not found in the CLow condition. In sum, the following two differences were found. First, with high malfunction rates, the "anshin" evaluations decreased uniformly, but the feeling of safety evaluations did not decrease for the high criticality features (i.e., automatic driving). Second, with moderate or low malfunction rates, the "anshin" evaluations increased uniformly, but the feeling of safety evaluations did not increase for the low criticality features (i.e., automatic wipers).

IV. CONCLUSION AND FUTURE WORK

The first goal of this study was to verify the differences between "anshin" and feeling of safety evaluations of automobile features having varying levels of safety criticality. The results revealed that the feeling of safety evaluations was higher than the "anshin" evaluations. Additionally, the higher the criticality, the higher both evaluations, but no difference was found between the two evaluations. The safety evaluations had been expected to be lower than the "anshin" evaluations for high criticality features, but they were higher overall. This indicates that "anshin" is more stringent than feeling of safety. This difference needs to be verified in future research.

The second goal was to verify the differences in changes in "anshin" and feeling of safety evaluations before and after the provision of information about the unstable performance of features having varying levels of criticality. The results revealed that both evaluations decreased in response to high malfunction rates, but the feeling of safety evaluations did not decrease for the high criticality features. Additionally, both evaluations increased for moderate or low malfunction rates, but the feeling of safety evaluations did not increase for the low criticality features.

It has been shown that drivers' trust in ACC decreases immediately after some problems of ACC are presented [14]. Assuming that ACC is a high criticality feature and that the information indicates instability, the finding is similar to this previous study that the information about a malfunctioning critical feature decreases "anshin" evaluations.

It is notable, however, that such a decrease was not ob-

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TABLE III
RESULTS OF FURTHER ANALYSIS OF MALFUNCTION × CRITICALITY × PHASE IN FEELING OF SAFETY EVALUATIONS

				df	F	p		η_p
CHigh[1]	Malfunction × Phase			$2, 122$	8.43	$< .001$	***	.12
		Phase	at MHigh[2]	$1, 39$	1.61	$.211$		.03
			at MMid[2]	$1, 42$	13.58	$< .001$	***	.24
			at MLow[2]	$1, 41$	14.78	$< .001$	***	.26
CMid[1]	Malfunction × Phase			$2, 122$	18.58	$< .001$	***	.23
		Phase	at MHigh[2]	$1, 39$	12.96	$< .001$	***	.24
			at MMid[2]	$1, 42$	6.49	$.014$	*	.13
			at MLow[2]	$1, 41$	30.43	$< .001$	***	.42
CLow[1]	Malfunction × Phase			$2, 122$	3.67	$.028$	*	.05
		Phase	at MHigh[2]	$1, 39$	6.15	$.017$	*	.13
			at MMid[2]	$1, 42$	1.61	$.211$		.03
			at MLow[2]	$1, 41$	0.89	$.348$		.02

[1] CHigh = Criticality High, CMid = Criticality Mid, CLow = Criticality Low.
[2] MHigh = Malfunction High, MMid = Malfunction Mid, MLow = Malfunction Low.
$*p < .05$, $***p < .001$.

served in the feeling of safety evaluations. That may be because feeling of safety evaluations involves a deep process with respect to the significance of the unstable-performance-related information of a critical feature. Although unstable performance is inherently problematic, it may be favorably interpreted as an indication of the technical complexity of a critical feature, preventing a decrease in feeling of safety evaluation. Similarly, feeling of safety evaluations did not improve when non-critical features were described as stable. The reason may be that the stable performance of low-critical features is objectively interpreted as non-relevant to safety. Further verification is needed on this point.

These findings that the feeling of safety is sensitive to feature criticality of function and information about unstable performance suggests the possibility that the feeling of safety is based on objective physical measurements. In this sense, "anshin" may be relatively insensitive and more subjective. Although it has been suggested that "anshin" includes processes of prediction and trust [4], whether the feeling of safety includes these processes must be carefully verified.

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