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Schandl, F., Lermer, E., & Hudecek, M. F. C. (2024). If It Concerns Me: An Experimental Investigation of the Influence of Psychological Distance on the Acceptance of Autonomous Shuttle Buses. *Collabra: Psychology*, *10*(1). https://doi.org/10.1525/collabra.118770

Social Psychology

If It Concerns Me: An Experimental Investigation of the Influence of Psychological Distance on the Acceptance of Autonomous Shuttle Buses

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Keywords: autonomous driving, artificial intelligence, technology acceptance, psychological distance, autonomous vehicle acceptance, construal level theory

https://doi.org/10.1525/collabra.118770

Collabra: Psychology

Vol. 10, Issue 1, 2024

Autonomous vehicles (AVs) will revolutionize our everyday mobility in the future. However, the prerequisite for this is that the technology is accepted by the population. Currently, AVs are still difficult to grasp for many people, i.e., the topic of autonomous driving is psychologically distant. In other contexts, it has been shown that this psychological distance or proximity can be used to influence product perception. However, the influence of psychological distance has never been investigated in the AV context. To address this research gap, we investigated the impact of psychological distance on the intention to use (ITU) AVs. We manipulated psychological distance in a 2x2x2 scenario-based experiment (N = 2114) on two different dimensions and additionally varied driving modality for comparison purposes: subjects either imagined themselves or an average person (social distance) using either a traditional or autonomous bus (driving modality) either today or in ten years (temporal distance). Our results showed a main effect of driving modality and social distance, with higher ITU for AVs and the average person. Temporal distance interacted with social distance to affect ITU. Interestingly, psychological distance also affected ITU for traditional buses with a similar interaction pattern. Thus, our study suggests that psychological distance affects the ITU of buses in general rather than AV technology. Providers can benefit from framing AVs as temporally close and providing as concrete, detailed information as possible. Future research should examine the underlying mechanisms (e.g., a shift in bus use priorities) that can explain why social distance plays an important role, particularly in future scenarios.

Introduction

Our mobility is about to face a fundamental change: autonomous driving. In about 20 years, autonomous vehicles (AVs) are expected to account for 50 % of new vehicles (Litman, 2022). To successfully integrate AVs into road traffic, acceptance by potential users is essential. To date, however, this technology remains hard to grasp for the general public, in large part because AVs have very limited availability and the underlying artificial intelligence (AI) technology is complex (Brell et al., 2019; Litman, 2022; Wiegand et al., 2020). In this context, autonomous driving is still very abstract on two levels in particular: first, it is a future, rather than an immediate development on a temporal level (Litman, 2022). Second, to date, autonomous driving is not yet personally relevant to most individuals due to its limited availability. Trope and Liberman (2010) refer to circumstances such as these as psychological distance. Numerous studies from a variety of fields show that this psychological distance is a key factor in shaping our judgments of situations and objects (e.g., Lermer et al., 2015, 2016a, 2016b; Pronin et al., 2008; So et al., 2021). Psychological distance is emerging in current research as a factor that significantly affects the perception and acceptance of new technologies (e.g., Bitcoin: Abraham et al., 2019; robots: Akdim et al., 2021; AI: Hudecek et al., 2024). New technologies can be

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perceived as distant to potential users at a temporal level when they are currently hardly available (Fraedrich & Lenz, 2016; Trope & Liberman, 2010). Similarly, developments that do not affect ourselves are distant at the social level (Trope & Liberman, 2010). In turn, these dimensions of psychological distance can significantly shape technology acceptance and intention to use (ITU). In this course, we aimed to focus on autonomous driving, which is currently hardly available and thus very abstract but could revolutionize everyday life for many people soon (Gavanas, 2019; Litman, 2022). Especially autonomous public or shared vehicles have great potential. As a comparatively resource-saving and efficient mobility solution, they can help to reduce the use of private cars and contribute to protecting the environment (e.g., through intelligent route planning, Chan & Shaheen, 2012; Gurumurthy et al., 2019). Therefore, it is important to identify the factors that contribute to the successful implementation of autonomous public vehicles (Schandl et al., 2023). To the best of our knowledge, we are the first study to use a large-scale experimental design to investigate the influence that psychological distance at the social and temporal level has on the acceptance of autonomous buses compared to traditional buses. We aim to draw practical implications for the current situation, in which autonomous driving is still hardly relevant in society, but society is slowly being familiarized with the new technology.

Literature Review and Research Framework

Psychological Distance and Construal Level Theory

Innovative technologies such as autonomous driving may be difficult for individuals to grasp due to their novelty and can cause uncertainty and skepticism (Jing et al., 2020; Zmud et al., 2016). An essential prerequisite and option for concretizing abstract representations such as those of AVs is to reduce the psychological distance. Psychological distance describes the extent to which a circumstance is "not part of one's direct experience" (Trope et al., 2007, p. 2). Trope and Liberman (2010) distinguish four different types of psychological distance: temporal distance (e.g., now vs. 10 years from now), spatial distance (e.g., here vs. on another continent), social distance (e.g., me vs. a stranger), and hypothetical distance (e.g., real vs. imagined). The classification of an object within these distances occurs automatically and on a continuum, and the different types of psychological distance can interact with each other (Trope & Liberman, 2010; Williams & Bargh, 2008). Psychological distance, in its total constellation, affects the perception and internal representation of objects. Trope and Liberman (2010) describe this cognitive-social psychological phenomenon using Construal Level Theory (CLT). According to the authors, objects that are psychologically distant from the subject are represented abstractly and theoretically. Due to their abstraction, these representations are usually poor in detail. To nevertheless develop an internal concept of the object, the missing details and information have to be compensated by one's own mental imagination, i.e., they are mentally constructed. Psychological distal objects, therefore, have a high construal level according to CLT. In contrast, objects that are close to the subject require a low construal level and allow for a more concrete, detailed mental representation (Trope & Liberman, 2010). Peng et al. (2013) figuratively compare a high construal level to the perspective of a bird viewing a sprawling forest from above. In contrast, they analogize a low construal level to an animal that closely sees single trees at the bottom of the forest.

With regard to the perception of new technologies, psychological distance seems to play a crucial role. New technologies such as AVs require a high construal effort at the cognitive level (Förster, 2009; Trope & Liberman, 2010). In parallel, several studies on CLT suggest that the extent of social and temporal psychological distance in particular has an impact on the acceptance of innovations. For example, Abraham et al. (2019) found in the context of cryptocurrencies that the lower the perceived spatial, social, and hypothetical distance, the higher was the ITU for Bitcoin and its blockchain. According to the author, potential users need to see the technology as concrete, relevant, and feasible for successful establishment (Abraham et al., 2019). This contrasts with findings on decision-making behavior, which show that risk perception (e.g., of new technologies) decreases under higher psychological distance (Lermer et al., 2015, 2016a, 2016b). A possible explanation for the divergent results is provided by Fujita et al. (2006). Thus, rational decision behavior is associated with an abstract mindset and affective decision behavior is associated with a concrete mindset. Following this reasoning, a low psychological distance could lead to higher risk perception via affect (e.g., fear). On the other hand, an affective component (e.g., fascination, curiosity) also might have a favorable effect on the acceptance of new technologies (e.g., Bitcoin, Abraham et al., 2019; autonomous driving, Brell et al., 2019). These findings are also found in the reverse way. In a letter recognition task, Förster (2009) showed that new subliminally presented stimuli are associated with global perception, and familiar stimuli are associated with detailed perception. He, therefore, hypothesized that people automatically encounter new events with more abstract perception at a high construal level, possibly to first roughly semantically categorize the new impression and thus classify the relevance and valence of the stimulus (Förster, 2009). Thus, the construal level and human perception seem to be in a reciprocal relationship.

Temporal psychological distance

Based on CLT, numerous studies demonstrate that temporally distant objects and events (i.e., located in the past or future) are represented more abstractly (Trope et al., 2007). This is in line with several findings that expand our understanding of the effects of temporal distance. Depending on the construal level, the acceptance of new technologies may depend on different factors. Bagratuni (2021) examined the relationship between affective and cognitive factors and the acceptance of air cabs on moderation by temporal distance. Consistent with the findings of Fujita et

al. (2006), he found that at a low temporal distance, affective factors, such as hedonic motivation, are primary determinants of acceptance. In contrast, when the temporal distance to air cabs was high, cognitive factors such as utility and safety concerns were primary. The hedonic motivation had no influence in this condition (Bagratuni, 2021). This finding is in line with Sagristano et al. (2002), who found that for temporally distant events, the focus was on the desirability, and for temporally proximal events, the focus was on the feasibility of the event. Possibly, high temporal distance favors the acceptance of new technologies because, although new technologies are often desirable per se (distal level), practical feasibility (proximal level) is often still difficult to imagine (Peng et al., 2013).

Social psychological distance

Another influential effect of psychological distance on cognition may be observed at the social level. We see and evaluate other people differently from ourselves, presumably because we can better comprehend our own cognitive processes, affective states, or the variability of our behavior (Trope & Liberman, 2010). Thus, social distance affects our perceptions and influences which aspects we consider in evaluation processes. J.-Z. Xu and Xie (2012) examined social distance by comparing the decision-making behavior of directly affected individuals (socially proximal) with that of advisors (socially distant). Low social distance showed a stronger focus on feasibility, while high social distance showed a stronger focus on desirability of an alternative. The authors also found that advisors' decision-making behavior was more similar to that for themselves when they perceived a similarity to the people involved. An interesting research area on social distance opened up in recent years around the acceptance of new technologies: According to Abraham et al. (2019), an abstract mindset positively affects the perceived social relevance of Bitcoin. This perceived relevance was in turn positively associated with ITU in their study. The authors reasoned that abstract technologies like Blockchain, require an abstract, open mindset to grasp the complexity of the technology. Consistent with this, Hudecek et al. (2024) found in their study of online medical advice that subjects preferred the advice of a human doctor to the advice of an AI. However, this difference could only be shown if the medical judgment concerned the subject's own person. For other, unknown persons (i.e., socially distant), the subjects showed no preference for a certain source of advice (Hudecek et al., 2024).

Findings on the interaction of different levels of psychological distance

The findings by Hudecek et al. (2024) provide evidence that psychological distance at one level (e.g., me vs. another person) influences the effects of psychological distance at another level (e.g., doctor vs. AI). Similar findings were found in a study by Peng et al. (2013): In cancer treatment imagining scenarios, subjects who opted for themselves preferred radiotherapy with a high treatment survival rate but a low five-year survival rate over surgery with a low treatment survival rate and high five-year survival rate. Subjects who judged for others showed an inverse pattern. According to the authors, individuals at low social distance may be more likely to focus on the present, and those at high social distance may be more likely to focus on the future. Thus, the level of social distance affected treatment decisions through the evaluation of temporal distance. An alternative explanation provided by the authors lies in the focus on feasibility vs. desirability described earlier. Thus, under social proximity, individuals may prefer radiation treatment with a higher chance of feasibility. Under social distance, on the other hand, the preference for surgical intervention predominates, which is more difficult to perform but more desirable in the long term (Peng et al., 2013). Pronin et al. (2008) also showed in their study that a higher hypothetical distance modulates the influence of temporal and social distance on decision behavior. In imagination scenarios, subjects were rather willing to drink the amount of an unenjoyable beverage that they would also ask a stranger or their future self to drink. Under real-life conditions, however, subjects chose smaller amounts for themselves (Pronin et al., 2008). These results are consistent with the assumptions of CLT that the psychological distance on one dimension influences the perceived psychological distance on another dimension (Trope & Liberman, 2010).

AV Acceptance

Studies such as Hudecek et al.'s (2024), but also e.g. by Larkin et al. (2022) or Luo et al. (2019) illustrate that people are currently still measurably more skeptical of AI-based technologies than of human performance. As AI progressively spreads into more areas of everyday life and promises far-reaching applications in the future (e.g., in the form of AVs, Jiang et al., 2022), a key goal is to prepare the general population for the implementation of artificially intelligent and autonomous technologies. The primary focus here is on the acceptance of the technologies, which is expressed in the ITU (Davis, 1985). In recent years, research on the acceptance of new technologies has opened a wide area of interest in the field of autonomous driving technology. In addition to extrapersonal factors (e.g. service and vehicle characteristics), studies are increasingly focusing on the influence of intrapersonal characteristics (e.g. sociodemographics, personality, perception) on ITU (Nordhoff et al., 2019). For example, it has already been observed that younger, male people with a higher level of education are more willing to accept AVs (Ding et al., 2022; Dong et al., 2019). Possible reasons for this are discussed by Schandl et al. (2023). In addition, it has been shown that personality has an influence on AV acceptance. People with high extraversion and openness, for example, have a higher ITU (Qu et al., 2021). In contrast, a low ITU is associated with increased neuroticism and general anxiety (Qu et al., 2021; Schandl et al., 2023). A significant role is also attributed to the individual need for control (Garidis et al., 2020). People with a high fear of giving up control show lower AV acceptance (Schandl & Hudecek, 2023), possibly because AVs are associated with safety concerns (Zmud et al., 2016). Consis-

tent with this, in the study of Detjen et al. (2020), perceived safety was the most frequently cited requirement for feelings of well-being and comfort during an AV ride.

A special focus of research on AV acceptance are autonomous public and shared vehicles. The implementation of autonomous driving technology in public transportation is considered as promising (Pakusch & Bossauer, 2017). For example, it allows intelligent route planning for users at low costs (Litman, 2022; Pakusch & Bossauer, 2017). This can help to reduce the traffic volume caused by private vehicles and thus have a positive impact on traffic flow and the reduction of greenhouse gas emissions (Litman, 2022; Pakusch & Bossauer, 2017). In addition, driverless buses allow to counter the shortage of bus drivers that has been observed in public transportation worldwide in recent years due to insufficient working conditions and structures (Aluwi et al., n.d.; H.-K. Chen et al., 2019). With mainly fixed routes, public and commercial transport is particularly suitable for the deployment of autonomous driving technology (Litman, 2022). According to Litman (2022), it will therefore be implemented in public transport as early as the 2030s and thus precede the establishment of autonomous private cars.

At present, AVs are hardly common and are therefore still abstract (i.e., psychologically distal) for society (Fraedrich & Lenz, 2016). As they become more established, AVs will become a current technology that will impact an increasing number of people. The psychological distance will therefore be reduced. From research on the acceptance of new technologies, we can assume that psychological distance may have a significant influence on the AV acceptance. To what extent psychological distance or a shift in psychological distance can affect the acceptance of AVs and autonomous buses, is still unclear.

Research Goal

The generation of psychological proximity or distance (e.g., through framing in advertising slogans) can influence object perception and acceptance (Reczek et al., 2018). So far, these phenomena have not been studied in an AV context. We aim to fill this research gap and investigate the role of psychological distance in the context of the acceptance for autonomous buses. To distinguish the effects due to autonomous technology from those shown for buses in general, we comparatively contrast autonomous buses and traditional buses in our study. We take up previous results and investigate 1. to what extent AV acceptance is influenced by temporal and social distance, and 2. if the results can be found exclusively for autonomous buses or also for traditional buses in general.

We assume that the temporal distance influences AV acceptance. The widespread availability of this technology is still in the future. Information about the timely implementation of AVs on the road could make the abstract notion of this technology more concrete and tangible. Moreover, examining the effect of temporal distance allows us to draw initial conclusions about the extent to which AV acceptance might change when AVs are a present, rather than a future, technology. In this study, we, therefore, manipulate temporal distance to AVs and examine the extent to which it affects ITU. AI technology and AVs may still be associated with reservations or uncertainty (Jing et al., 2020; Zmud et al., 2016), so we hypothesize that temporally distal, abstract framing will be less threatening to subjects and therefore result in an increased ITU (Lermer et al., 2016b):

> *H1. Temporal distance (now vs. 10 years from now) has a positive effect on ITU.*

Hudecek et al. (2024) showed that social distance also has a significant influence on the acceptance of AI systems. When people themselves were affected by an AI-based advice, they were more skeptical than they were when others were affected by it. We would like to take up this finding and investigate to what extent social distance plays a role in the ITU of AVs. This may help to understand how AV acceptance may be influenced by the purposeful framing of social distance, e.g., for marketing purposes. Based on the findings of Hudecek et al. (2024), who showed that AI technology is more likely to be accepted when it does not affect oneself, we hypothesize H2:

> *H2. Social distance (self vs. others) has a positive influence on ITU.*

To interpret the results, we need to understand to what extent the influences of psychological distance are specific to autonomous AI technology, which is still abstract, or to traditional buses, which are already available and relevant to individuals. As shown, people prefer decisions by a human source instead of an AI (Hudecek et al., 2024). We, therefore, hypothesize the following regarding the driving modality.

> *H3. The bus modality has an influence on ITU, with lower ITU for autonomous buses compared to traditional buses.*

According to CLT, the distance on one dimension can influence the perceived distance on another dimension (Trope & Liberman, 2010). The authors describe social distance as a "core psychological distance" (Trope & Liberman, 2010, p. 444). According to this theory, we therefore assume in our theoretical model that temporal distance affects the impact of social distance. Thus, high temporal distance in our study can diminish the effect of social distance and vice versa. Accordingly, the closer in time to the introduction of AV, the more relevant is the extent to which it affects a person himself (Trope & Liberman, 2010). Similarly, temporal distance should also play a smaller role for ITU when subjects evaluate for an unknown person (social distance). In this context, it is logical to assume that the role of driving modality is reduced when temporal or social distance is high. We also hypothesize, in reverse, that when temporal or social proximity is present, driving modality has a greater impact on ITU because consequences become more tangible when temporal and social distance effects are more direct. From these considerations, we derive hypothesis H4 to H6:

> *H4. The influence of social distance on the ITU is smaller under temporal distance.*

> *H5. The influence of the bus modality (autonomous vs. traditional) is smaller under temporal distance.*
> *H6. The influence of the bus modality (autonomous vs. traditional) is smaller under social distance.*

Method

Sample

To ensure a strong power and informative value with the eight planned conditions of our experiment, we set the sample size in advance to at least 700 participants using the software G*Power, version 3.1.9.4, for a power of .95 (f = .20, α = .05; Kadam & Bhalerao, 2010).The final sample comprised 2,114 participants (n = 1,437 female, 664 male, 13 divers), who were between 16 and 77 years old (M = 26.20, SD = 8.61). They were recruited via social media and online platforms of the University of Regensburg, the University of Munich, and the FOM University. For study participation, participants had to be at least 16 years old. Three subjects who were younger were excluded in advance. In addition, 38 persons who had not completed the questionnaire completely were excluded prior to the analysis. Students received course credit for participation; apart from that, study participation was without further compensation or reward.

Design

The study was part of a large-scale research project that explored the acceptance of autonomous shuttle buses on a public test route in the city of Regensburg (Germany). In this context we conducted a preregistered (https://osf.io/pbwrc) 2x2x2 scenario-based experiment. We initially started the data collection with four conditions manipulating social distance and bus modality using the present tense (temporal proximal). After the first 400 surveys, we extended the design to include the temporal distance condition. In other words, we added four more conditions in the future tense ("in 2033", temporal distal). We continued the further surveys with randomized assignment to one of the eight conditions with the aim of balancing the group sizes as far as possible. All conditions surveyed were included in the present study. Temporal distance was manipulated by temporal reference (today vs. 10 years from now), and social distance via the user's affectedness by the technology (me vs. another average person). In addition, we differentiated the bus modality (autonomous vs. traditional). For this purpose, we asked the participants to imagine themselves (socially proximal) using or an average person (socially distal) using an autonomous shuttle bus or a traditional bus today (temporally proximal) or in ten years (temporally distal). Assignment to each condition was randomized. This resulted in eight possible combinations:

- I use a traditional bus today. (temporally proximal, socially proximal, traditional)
- I use an autonomous bus today. (temporally proximal, socially proximal, autonomous)
- An average person uses a traditional bus today. (temporally proximal, socially distal, traditional)
- An average person uses an autonomous bus today. (temporal proximal, social distal, autonomous)
- I will use a traditional bus in 10 years. (temporal distal, social proximal, traditional)
- I will use an autonomous bus in 10 years. (temporal distal, social proximal, autonomous)
- An average person will use a traditional bus in 10 years. (temporal distal, social distal, traditional)
- An average person will use an autonomous bus in 10 years. (temporal distal, social distal, autonomous)

Instruments

We measured ITU using behavioral intention scale developed by Venkatesh et al. (2012) on a seven-point Likert scale ranging from "Strongly disagree" (1) to "Strongly agree" (7). The items were adopted by the authors and adapted in wording to the (autonomous or traditional) bus context as well as the distance condition (temporal and social). Internal consistency was excellent with McDonald's ω = .91 (Blanz, 2015; McDonald, 2013; Zinbarg et al., 2005).

The study was part of a larger study project on autonomous shuttle buses. Therefore, we also collected the variables of the extended Unified Theory of Acceptance and Use of Technology (performance expectancy effort expectancy social influence facilitating circumstances hedonic motivation price and habit, Venkatesh et al., 2012) as well as disposition to trust (Gefen & Straub, 2004), perceived safety (Z. Xu et al., 2018), travel behavior and the price subjects would be willing to pay for a day ticket. To avoid impairing the clarity and interpretability of the results, we decided against including these variables in our analysis after we had extended the study design to eight conditions. An overview of all items used in the study is available in the OSF repository, https://osf.io/ayq9p.

Statistical analysis

Statistical analysis was performed using the statistical program R (Version: 2023.12.0) with the car-package (Fox & Weisberg, 2019). In advance, we ensured that the data set did not have extreme outliers that were more than three times the interquartile range from the mean (Balducci et al., 2019). We conducted a three-factor ANOVA without repeated measures to test the influence of social and temporal distance and bus modality on ITU. The conditions for conducting ANOVA are independence of measurements, interval scaling, and normal distribution of the criterion, as well as variance homogeneity within factor groups (Rasch et al., 2021). We considered the first two conditions to be met in our experimental design. A significant Shapiro-Wilk test revealed the non-normal distribution of the data (Shapiro & Wilk, 1965). However, in analyses with sufficiently large samples, ANOVA is considered robust to the violation of this assumption, so we decided to neglect this aspect in our study (Blanca et al., 2017). Levene's test for variance homogeneity proved significant, indicating variance heterogeneity, possibly due to the sensitivity of the test to large samples (Field, 2013). Violation of this last assumption may lead to a bias in the Type I error rate

Table 1. Correlations of ITU with independent variables

Variable	1. ITU	2. Temporal Distance	3. Social Distance
1. ITU			
2. Temporal Distance	.04		
3. Social Distance	.09**	.00	
4. Bus Modality	.10**	.01	.00

Note. ITU = Intention to Use.
$N = 2114$.
*: $p < .05$
**: $p < .01$

(Delacre et al., 2019). To control for this, we performed an analysis with bootstrapping (1000 repetitions), which is robust to variance heterogeneity, in addition to the F statistic of the classic ANOVA (Krishnamoorthy et al., 2007). The dataset of the current study is available in the OSF repository, https://osf.io/ayq9p.

Results

Table 1 displays the correlations of the considered variables and conditions. We calculated a 2x2x2 ANOVA to investigate the influence of temporal distance (proximal vs. distal), social distance (proximal vs. distal), and driving modality (autonomous vs. traditional) on ITU.

The overall model contributed moderately (*adjusted* R^2 = .04) to the variance explanation of ITU (Cohen, 2013). The results are presented in Table 2. For temporal distance, contrary to our assumption, there was no significant main effect (H1 not confirmed). At the social distance level, ITU proved to be significantly higher in pairwise comparisons when rated for others than for oneself (H2 supported). Overall, ITU was higher for autonomous buses than for traditional buses, with a significant main effect of driving modality. Therefore, H3, in which we expected a significant main effect of driving modality but with a higher ITU in the traditional conditions, is not confirmed. Despite the significant results, the effect sizes for the main effects were marginal with $\eta^2 \leqslant .01$ (Cohen, 2013; Sauer, 2019).

Temporal distance interacted significantly with social distance. Figure 1 shows the interaction pattern for both the autonomous and traditional conditions. In the temporally proximal conditions, subjects rated ITU similarly high for themselves and for others, with a (nonsignificant) slightly higher ITU when judging for themselves. However, this pattern reversed in the temporally distal conditions. For future scenarios, subjects estimated their ITU to be lower than for present scenarios. In contrast, the ITU that participants attributed to others in the future was significantly higher than the present ITU. Thus, while social distance in the temporally proximal conditions caused little difference in ITU, in the temporally distant condition ITU attributed to others was substantially higher than ITU attributed by subjects to themselves. Contrary to H4, temporal distance increased the influence of social distance instead of reducing it. Interestingly, this interaction appeared largely independent of driving modality; thus, the interaction of all three factors was not significant. Driving modality also did not interact significantly with either level of psychological distance (H5 and H6 not confirmed). The effect sizes of the interactions were marginal with partial $\eta^2 \leqslant .01$ (Cohen, 2013). At a significance level of $\alpha = .05$, our study showed a statistical power of .99. As our data did not meet the assumptions of normal distribution, we also carried out the analysis using bootstrapping with 5000 iterations. The results pattern of the ANOVA with bootstrapping was identical to the ANOVA without distribution assumption und therefore fully supports the previous findings (see Table 2).

Discussion

Summary and Practical Implications

The aim of our study was to investigate the influence of different dimensions of psychological distance on AV acceptance to make predictions and suggestions for successful AV implementation. To this end, we manipulated temporal and social distance as well as driving modality in a large-scale experiment using a scenario-based approach and examined ITU as the relevant outcome variable.

We were able to document substantial influences of psychological distance at the temporal and social level. This emphasizes the importance of temporal and social tangibility in successful AV adoption. Our study was, to the best of our knowledge, the first to date devoted to psychological distance in the AV context. A major strength of the study is the large-scale experimental design, which allowed us to uncover causal influences of psychological distance on ITU. Thus, we were able to draw direct conclusions about the direction of effects. In addition, the design of our study allowed us to observe not only the individual dimensions of psychological distance but also their multidimensional interaction. To investigate which effects of psychological distance are actually specific to autonomous driving technology, we compared the autonomous conditions to traditional buses. The large sample is another important advantage of our study as it strengthens the validity of the current results. In total, we obtained three main findings:

First, regardless of temporal and social distance, the autonomous bus was better accepted. This contradicts our initial expectation and also previous studies that showed that AVs tend to be met with even more criticism than traditional vehicles (e.g., Clayton et al., 2020; Hewitt et al., 2019. Indeed, autonomous buses were even encountered with considerably more openness. Schandl and Hudecek

Table 2. ANOVA results with criterion ITU

Factors	Classic ANOVA					Bootstrapping ANOVA
	F	df	p	Partial η^2	95 % CI	p
Temporal Distance	3.21	1	.073	.002	[0.000, 0.005]	.066
Social Distance	15.92	1	< .001	.008	[0.002, 0.015]	< .001
Bus Modality	23.23	1	< .001	.010	[0.003, 0.018]	< .001
Temporal Distance x Social Distance	16.90	1	< .001	.008	[0.002, 0.015]	< .001
Temporal Distance x Driving Modality	0.11	1	.746	.000	[0.000, 0.001]	.740
Social Distance x Driving Modality	2.48	1	.116	.001	[0.000, 0.000]	.111

Note. ITU = Intention to Use; CI = Confidence Interval.
N = 2114.

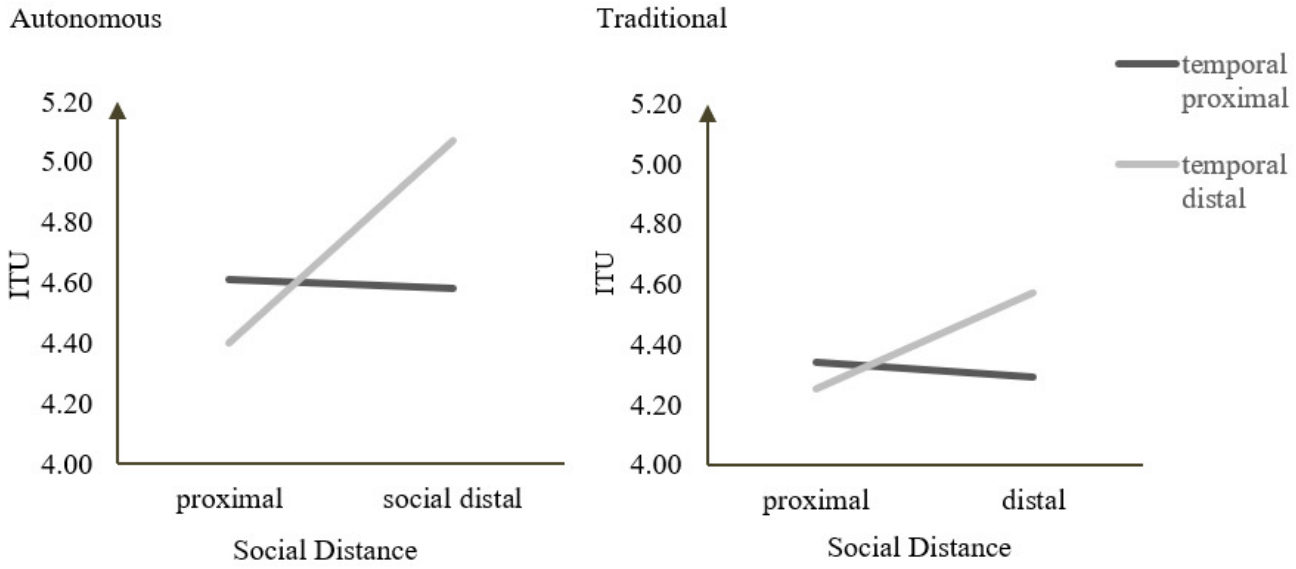

Figure 1. Graphical visualization of the interaction effects per driving modality

(2023) were able to identify this phenomenon in a real-life-condition study in which passengers of autonomous and traditional buses were interviewed while driving. Perhaps one reason for this is that AV technology and its advantages over traditional vehicles are now more recognized (e.g., with regard to driving safety or traffic flow, Litman, 2022). Especially in large cities (e.g., Munich or Regensburg), where a significant part of the sample was recruited, there are pilot projects on autonomous buses through which the population might be better familiarized with AVs (Bundesministerium für Digitales und Verkehr, 2021; Hartl, 2021). In addition, autonomous driving assistance systems (e.g., parking or lane-keeping assistants) are meanwhile widely used and allow drivers first contact with autonomous driving technology. Maybe this removes skepticism (Sharma & Garg, 2022). For the successful adoption of autonomous buses, the results of our study are a positive outlook because they show that people are open to this new technology. This suggests that autonomous buses might be welcomed even when widely introduced on the roads and could be a remarkable alternative to traditional buses. This is a promising prognosis for the AV future.

Second, ITU in our study was influenced by social distance, which in turn additionally interacted with temporal distance. The results are consistent with the study by Hudecek et al. (2024), in which subjects accepted AI as an alternative to human medical opinion for others but preferred human judgment for themselves. In the AV context subjects attributed a higher ITU to others than to themselves. However, this effect of social distance in our study is almost entirely due to the results of the temporally distal conditions. For temporally proximal manipulations, this effect was not evident. Rather, subjects actually rated their own ITU higher than the ITU of others in immediate situations, although not significantly. Thus, the two dimensions of psychological distance interacted. The direction of

the interaction, however, is surprising. We expected the influence of social distance to be especially crucial in temporally proximate scenarios because the idea of driverless driving should seem more threatening and risky, especially to oneself and again especially under temporal relevance (Lermer et al., 2016a, 2016b). At the same time, we hypothesized that social distance would be less influential in future conditions because temporal distance would make the scenario seem less relevant to the person. This assumption was consistent with CLT, according to which high psychological distance at one level diminishes the influence of psychological distance at another level (Trope & Liberman, 2010). However, our results showed an opposite pattern: especially in future scenarios, social distance was determinant, with a higher attributed ITU for others. One explanation for the discrepancy between the results and the assumptions could be that, according to the authors of the CLT, temporally distal framing favors the clarity of preferences, even if temporally distal events are less tangible (Liberman & Trope, 2003; Trope & Liberman, 2003a, 2003b). Accordingly, the results would be due to clearer decision behavior in the temporally distal condition, which may in turn have made social distance more influential. Another explanation is that the manipulation of psychological distance caused a shift in bus use priorities. As presented earlier, several studies suggest that temporal proximity directs cognitive focus to feasibility, whereas psychological distance favors focus on aspects of desirability (Kim et al., 2009; Sagristano et al., 2002). It is possible that the manipulation of temporal distance resulted in ITU being evaluated once with respect to feasibility and once with respect to desirability, depending on the condition. Thus, with this interpretation, psychological distance would not directly affect ITU. Rather, the distance manipulation would cause a shift in priorities (feasibility vs. desirability) that would result in different ITU ratings. Assuming this shift in priorities, in our study context, this would mean that the autonomous bus would be willingly used if feasibility (i.e., proximal temporal distance), the "how?" is the primary concern (Kim et al., 2009). In terms of feasibility, the autonomous bus seems to be appealing to oneself and also to strangers. If the focus is on desirability (i.e., distal temporal distance), the "why?", we are personally less likely to use the autonomous bus (Kim et al., 2009). In contrast, for other individuals, we suspect a high ITU in this context. The clearer decision behavior or priority shift are possible reasons for the effects of temporal distance on ITU.

Third, the main effect of social distance and the interaction pattern of social and temporal distance emerged not only for autonomous but also for traditional buses, with a higher ITU for autonomous buses across all conditions. This finding is key to the interpretation of our previous results. Indeed, the similarity of the pattern for both driving modalities indicates that our results are less due to the autonomous technology and perhaps more due to the general context of a bus driving experience. If we assume that decision behavior was clearer in the temporally distal condition, this is also applicable to traditional buses. Also, the priority shift to feasibility (temporally proximal condition) or desirability (temporally distal condition) would thus show up in a similar way for autonomous as well as traditional buses. The suggestion, therefore, is that these findings relate less to autonomous technology and more to the characteristic that underlies both driving modalities, i.e., bus driving.

These results at the same time illustrate that the focus of research on AV adoption should not lie on the acceptance of autonomous buses but on the acceptance of buses in general. In our study, the manipulation of psychological distance affected ITU almost independently of bus modality: The interaction pattern we found for autonomous buses was similarly evident for traditional buses. Therefore, the practical implications apply equally to both autonomous and traditional buses. Buses are accepted and recognized as a viable transportation alternative. Our study provides evidence that buses are accepted primarily when it comes to pragmatic feasibility and less when it comes to desirability. Accordingly, bus providers should, on the one hand, focus their marketing efforts on emphasizing the pragmatic utility aspects of buses (e.g., cost advantage over car use or parking independence). At the same time, the second goal should be to increase desirability, which may be less convincing so far. To make bus riding desirable away from instrumental benefits, the focus should be on hedonic affective factors (Redman et al., 2013). For example, the opportunity for social interaction or productive activities could be more emphasized, or bus travel could be specifically marketed as a relaxing period (Vos et al., 2020). Another key finding is that subjects in the temporally concrete conditions rated their ITU higher. From this, we infer that concrete information on the timely introduction of AVs can favor adoption (Reczek et al., 2018). AV marketing should rely as much as possible on detailed, vivid information that makes AVs more tangible to potential users. The focus should be more on emotional visual language (e.g., photos of the buses), rather than cognitive verbal language (e.g., slogans), to make mental representations more concrete (Amit et al., 2013; Septianto & Pratiwi, 2016).

Limitations

As with all such studies, some limitations offer opportunities for further research. First, we had to use scenario-based instructions to manipulate the experimental conditions to induce social and temporal distance. For example, subjects were asked to imagine themselves in the perspective of another person using an autonomous bus ten years from now. This allowed us to examine psychological distance from multiple dimensions. Several studies from different fields have shown that scenario-based experiments in particular have a high external validity and produce comparable results to field experiments (e.g. G. Chen et al., 2019; Weyrich et al., 2020; Zhang et al., 2023). However, impressions are based on one's own imagination. Therefore, we cannot eliminate the possibility that another dimension of psychological distance was involved in our study: hypothetical distance. Hypothetical distance refers to the extent to which a perception is real (proximal) or imagined (distal). Thus, the scenario-based instruction

might have induced hypothetical distance, which in turn acted on or interacted with other levels of psychological distance (Trope & Liberman, 2010). It is possible, for example, that personal involvement or temporal immediacy were perceived as less relevant because subjects knew that the situation was not real (Pronin et al., 2008). It remains unanswered to what extent hypothetical distance had an effect in our study.

Another limitation is the generalizability of our results. Even though our sample was very large, it was not balanced with respect to sociodemographic variables. As a result, it has a higher proportion of female, younger, and academic individuals than the average population. In particular, gender and age may influence the ITU of AVs (Ding et al., 2022; Dong et al., 2019). The extent to which the results are representative of different populations remains to be verified.

Future Research

The findings and limitations presented above provide a starting point for further examination. Our study yielded surprising findings that open up promising research opportunities. We were able to show that temporal and social distance, especially in their interaction, influence ITU. However, the pattern of interaction was found to be opposite to what was expected: Especially in conditions with high temporal distance, social distance was more influential, with a higher ITU attributed to other persons than to the self. These results highlight the relevance of psychological distance to bus acceptance. A first goal of future studies may be to replicate these results in different contexts (e.g., age groups, cultures, etc.). Furthermore, our study focused specifically on public transport as part of a research project on autonomous shuttle buses. We were able to show that the interaction patterns can be found equally for autonomous and traditional buses. It is therefore conceivable that the interaction pattern is determined by the framework of public transport, instead of the bus modality (autonomous vs. traditional). This raises the question of the extent to which the findings from our study focusing on public transport can be transferred to other vehicles (e.g., autonomous and traditional cars). For example, it is conceivable that people under socially distal conditions generally consider public transport use to be reasonable for environmental reasons, but reject it if they were directly affected, e.g., for reasons of convenience (Eriksson et al., 2013; Stojic et al., 2020). This main effect of social distance could therefore be reversed for private vehicles. These are possibly more convenient for the individual to use, but less sustainable and therefore generally to be less advocated (Eriksson et al., 2013; Stojic et al., 2020). It remains the task of future research to investigate these questions and assumptions regarding transferability to other means of transportation.

In parallel, further research is needed to clarify the expectation-contradictory results. We derived from the results the assumption that psychological distance could possibly not have a direct effect on ITU but conditioned a change in priorities (feasibility in proximal conditions vs. desirability in distal conditions). This assumption should be investigated in follow-up research, e.g., by additionally assessing the perceived feasibility and desirability of AVs and buses, respectively. This should include an investigation of the extent to which their influence on ITU changes as a function of psychological distance. If the assumption of priority shifting cannot be substantiated, further explanations for the interaction patterns have to be derived and verified. A further logical step is to replicate the results under real conditions. As described earlier, our study was scenario-based. This procedure was necessary to ensure the experimental manipulation of temporal distance and to induce future imagination. Once AVs become widely available, studies should at least manipulate social distance under real-world conditions, e.g., by allowing subjects to decide whether they themselves or other people prefer to use a real (autonomous) bus or car to drive a certain distance. In this way, possible influences discussed in the limitations could be controlled, e.g., by the hypothetical distance, and results could be validated.

Conclusion

Our study represents an initial attempt to investigate the influence of psychological distance on AV acceptance. Our aim was to investigate how psychological distance affects ITU of autonomous vs. traditional buses. Our extensive 2x2x2 experimental study yielded surprising findings. It showed that psychological distance has a significant effect on the acceptance of both autonomous and traditional buses. According to these findings, we were able to derive practical implications for ITU and the acceptance of buses. Future studies can address these findings and develop them further.

Contributions

Contributed to conception and design: FS, MFCH, EL

Contributed to acquisition of data: FS, MFCH

Contributed to analysis and interpretation of data: FS, MFCH

Drafted and/or revised the article: FS, MFCH

Approved the submitted version for publication: FS, MFCH, EL

Competing Interests

All authors declare that they have no conflicts of interest.

Funding Statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data Accessibility and Open Science Statement

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in

the study. The original data set, the syntax for the statistical analysis and an overview of all items used in the study are available in the OSF repository, https://osf.io/ayq9p.

Submitted: September 09, 2023 PDT, Accepted: May 14, 2024 PDT

References

Abraham, J., Sutiksno, D. U., Kurniasih, N., & Warokka, A. (2019). Acceptance and Penetration of Bitcoin: The Role of Psychological Distance and National Culture. *SAGE Open*, *9*(3). https://doi.org/10.1177/2158244019865813

Akdim, K., Belanche, D., & Flavián, M. (2021). Attitudes toward service robots: analyses of explicit and implicit attitudes based on anthropomorphism and construal level theory. *International Journal of Contemporary Hospitality Management*. Advance online publication. https://doi.org/10.1108/IJCHM-12-2020-1406

Aluwi, A. H., Mohd, I. H., & Daud, A. (n.d.). Linking Compensation to HR strategy: Overcoming Bus Driver Shortage in Malaysia. *International Foundation for Research and Development (IFRD)*.

Amit, E., Wakslak, C., & Trope, Y. (2013). The use of visual and verbal means of communication across psychological distance. *Personality & Social Psychology Bulletin*, *39*(1), 43–56. https://doi.org/10.1177/0146167212460282

Bagratuni, M. (2021). *An Empirical Investigation on the Influence of Temporal Distance on the Acceptance of Innovations - Using the Example of Urban Air Mobility*. https://doi.org/10.31219/osf.io/ud3qp

Balducci, S., D'Errico, V., Haxhi, J., Sacchetti, M., Orlando, G., Cardelli, P., Vitale, M., Bollanti, L., Conti, F., Zanuso, S., Lucisano, G., Nicolucci, A., & Pugliese, G. (2019). Effect of a Behavioral Intervention Strategy on Sustained Change in Physical Activity and Sedentary Behavior in Patients With Type 2 Diabetes: The IDES_2 Randomized Clinical Trial. *JAMA*, *321*(9), 880–890. https://doi.org/10.1001/jama.2019.0922

Blanca, M. J., Alarcón, R., Arnau, J., Bono, R., & Bendayan, R. (2017). Non-normal data: Is ANOVA still a valid option? *Psicothema*, *29*(4), 552–557. https://doi.org/10.7334/psicothema2016.383

Blanz, M. (2015). *Forschungsmethoden und Statistik für die Soziale Arbeit. Grundlagen und Anwendungen*. Kohlhammer. https://doi.org/10.17433/978-3-17-025836-5

Brell, T., Philipsen, R., & Ziefle, M. (2019). Scary! Risk Perceptions in Autonomous Driving: The Influence of Experience on Perceived Benefits and Barriers. *Risk Analysis*, *39*(2), 342–357. https://doi.org/10.1111/risa.13190

Bundesministerium für Digitales und Verkehr. (2021). *Testfeld München – Pilotversuch urbaner automatisierter Straßenverkehr – TEMPUS*. https://www.bmdv.bund.de/SharedDocs/DE/Artikel/DG/AVF-projekte/tempus.html

Chan, N. D., & Shaheen, S. A. (2012). Ridesharing in North America: Past, Present, and Future. *Transport Reviews*, *32*(1), 93–112. https://doi.org/10.1080/01441647.2011.621557

Chen, G., Smith, T. A., Kirkman, B. L., Zhang, P., Lemoine, G. J., & Farh, J.-L. (2019). Multiple team membership and empowerment spillover effects: Can empowerment processes cross team boundaries? *The Journal of Applied Psychology*, *104*(3), 321–340. https://doi.org/10.1037/apl0000336

Chen, H.-K., Chou, H.-W., Su, J.-W., & Wen, F.-H. (2019). Structural interrelationships of safety climate, stress, inattention and aberrant driving behavior for bus drivers in Taiwan. *Transportation Research Part a: Policy and Practice*, *130*, 118–133. https://doi.org/10.1016/j.tra.2019.09.007

Clayton, W., Paddeu, D., Parkhurst, G., & Parkin, J. (2020). Autonomous vehicles: who will use them, and will they share? *Transportation Planning and Technology*, *43*(4), 343–364. https://doi.org/10.1080/03081060.2020.1747200

Cohen, J. (2013). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Taylor and Francis.

Davis, F. D. (1985). *A technology acceptance model for empirically testing new end-user information systems: Theory and results*.

Delacre, M., Leys, C., Mora, Y. L., & Lakens, D. (2019). Taking Parametric Assumptions Seriously: Arguments for the Use of Welch's F-test instead of the Classical F-test in One-Way ANOVA. *International Review of Social Psychology*, *32*(1), 1–12. https://doi.org/10.5334/irsp.198

Detjen, H., Pfleging, B., & Schneegass, S. (2020). A Wizard of Oz Field Study to Understand Non-Driving-Related Activities, Trust, and Acceptance of Automated Vehicles. In *12th International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (pp. 19–29). ACM. https://doi.org/10.1145/3409120.3410662

Ding, Y., Li, R., Wang, X., & Schmid, J. (2022). Heterogeneity of autonomous vehicle adoption behavior due to peer effects and prior-AV knowledge. *Transportation*, *49*(6), 1837–1860. https://doi.org/10.1007/s11116-021-10229-w

Dong, X., DiScenna, M., & Guerra, E. (2019). Transit user perceptions of driverless buses. *Transportation*, *46*(1), 35–50. https://doi.org/10.1007/s11116-017-9786-y

Eriksson, L., Friman, M., & Gärling, T. (2013). Perceived attributes of bus and car mediating satisfaction with the work commute. *Transportation Research Part a: Policy and Practice*, *47*, 87–96. https://doi.org/10.1016/j.tra.2012.10.028

Field, A. P. (2013). *Discovering statistics using IBM SPSS statistics: And sex and drugs and rock "n" roll* (4th ed.). SAGE Publications Ltd.

Förster, J. (2009). Cognitive consequences of novelty and familiarity: How mere exposure influences level of construal. *Journal of Experimental Social Psychology*, *45*(2), 444–447. https://doi.org/10.1016/j.jesp.2008.10.011

Fox, J., & Weisberg, S. (2019). *An R companion to applied regression* (Third edition). SAGE.

Fraedrich, E., & Lenz, B. (2016). Societal and Individual Acceptance of Autonomous Driving. In M. Maurer, J. C. Gerdes, B. Lenz, & H. Winner (Eds.), *Autonomous Driving* (pp. 621–640). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-48847-8_29

Fujita, K., Trope, Y., Liberman, N., & Levin-Sagi, M. (2006). Construal levels and self-control. *Journal of Personality and Social Psychology*, *90*(3), 351–367. https://doi.org/10.1037/0022-3514.90.3.351

Garidis, K., Ulbricht, L., Rossmann, A., & Schmäh, M. (2020). Toward a User Acceptance Model of Autonomous Driving. In T. Bui (Ed.), *Proceedings of the 53rd Hawaii International Conference on System Sciences*. Hawaii International Conference on System Sciences. https://doi.org/10.24251/HICSS.2020.170

Gavanas, N. (2019). Autonomous Road Vehicles: Challenges for Urban Planning in European Cities. *Urban Science*, *3*(2), 61. https://doi.org/10.3390/urbansci3020061

Gefen, D., & Straub, D. W. (2004). Consumer trust in B2C e-Commerce and the importance of social presence: experiments in e-Products and e-Services. *Omega*, *32*(6), 407–424. https://doi.org/10.1016/j.omega.2004.01.006

Gurumurthy, K. M., Kockelman, K. M., & Simoni, M. D. (2019). Benefits and Costs of Ride-Sharing in Shared Automated Vehicles across Austin, Texas: Opportunities for Congestion Pricing. *Transportation Research Record: Journal of the Transportation Research Board*, *2673*(6), 548–556. https://doi.org/10.1177/0361198119850785

Hartl, J. (2021). So fährt Regensburgs autonomes Shuttle. *Mittelbayerische Zeitung*. https://www.mittelbayerische.de/region/regensburg-stadt-nachrichten/so-faehrt-regensburgs-autonomes-shuttle-21179-art2036847.html

Hewitt, C., Politis, I., Amanatidis, T., & Sarkar, A. (2019). Assessing public perception of self-driving cars: The autonomous vehicle acceptance model. In *Proceedings of the 24th international conference on intelligent user interfaces* (pp. 518–527). https://doi.org/10.1145/3301275.3302268

Hudecek, M. F. C., Lermer, E., Gaube, S., Cecil, J., Heiss, S. F., & Batz, F. (2024). Fine for others but not for me: The role of perspective in patients' perception of artificial intelligence in online medical platforms. *Computers in Human Behavior: Artificial Humans*, *2*(1), 100046. https://doi.org/10.1016/j.chbah.2024.100046

Jiang, Y., Li, X., Luo, H., Yin, S., & Kaynak, O. (2022). Quo vadis artificial intelligence? *Discover Artificial Intelligence*. Advance online publication. https://doi.org/10.1007/s44163-022-00022-8

Jing, P., Xu, G., Chen, Y., Shi, Y., & Zhan, F. (2020). The Determinants behind the Acceptance of Autonomous Vehicles: A Systematic Review. *Sustainability*, *12*(5), 1719. https://doi.org/10.3390/su12051719

Kadam, P., & Bhalerao, S. (2010). Sample size calculation. *International Journal of Ayurveda Research*, *1*(1), 55–57. https://doi.org/10.4103/0974-7788.59946

Kim, H., Rao, A. R., & Lee, A. Y. (2009). It's Time to Vote: The Effect of Matching Message Orientation and Temporal Frame on Political Persuasion. *Journal of Consumer Research*, *35*(6), 877–889. https://doi.org/10.1086/593700

Krishnamoorthy, K., Lu, F., & Mathew, T. (2007). A parametric bootstrap approach for ANOVA with unequal variances: Fixed and random models. *Computational Statistics & Data Analysis*, *51*(12), 5731–5742. https://doi.org/10.1016/j.csda.2006.09.039

Larkin, C., Drummond Otten, C., & Árvai, J. (2022). Paging Dr. JARVIS! Will people accept advice from artificial intelligence for consequential risk management decisions? *Journal of Risk Research*, *25*(4), 407–422. https://doi.org/10.1080/13669877.2021.1958047

Lermer, E., Streicher, B., Sachs, R., Raue, M., & Frey, D. (2015). The effect of construal level on risk-taking. *European Journal of Social Psychology*, *45*(1), 99–109. https://doi.org/10.1002/ejsp.2067

Lermer, E., Streicher, B., Sachs, R., Raue, M., & Frey, D. (2016a). The Effect of Abstract and Concrete Thinking on Risk-Taking Behavior in Women and Men. *SAGE Open*, *6*(3), 215824401666612. https://doi.org/10.1177/2158244016666127

Lermer, E., Streicher, B., Sachs, R., Raue, M., & Frey, D. (2016b). Thinking Concretely Increases the Perceived Likelihood of Risks: The Effect of Construal Level on Risk Estimation. *Risk Analysis*, *36*(3), 623–637. https://doi.org/10.1111/risa.12445

Liberman, N., & Trope, Y. (2003). Construal level theory of intertemporal judgment and decision. In G. Loewenstein, D. Read, & R. Baumeister (Eds.), *Time and decision: Economic and psychological perspectives on intertemporal choice* (pp. 245–276). Russell Sage Foundation.

Litman, T. (2022). *Autonomous vehicle implementation predictions: Implications for Transport Planning*. Victoria Transport Policy Institute.

Luo, X., Tong, S., Fang, Z., & Qu, Z. (2019). *Machines versus Humans: The Impact of AI Chatbot Disclosure on Customer Purchases*. https://doi.org/10.2139/ssrn.3435635

McDonald, R. P. (2013). *Test Theory: A Unified Treatment*. Psychology Press. https://doi.org/10.4324/9781410601087

Nordhoff, S., Kyriakidis, M., van Arem, B., & Happee, R. (2019). A multi-level model on automated vehicle acceptance (MAVA): A review-based study. *Theoretical Issues in Ergonomics Science*, *20*(6), 682–710. https://doi.org/10.1080/1463922X.2019.1621406

Pakusch, C., & Bossauer, P. (2017). User Acceptance of Fully Autonomous Public Transport. In *Proceedings of the 14th International Joint Conference on e-Business and Telecommunications*. SCITEPRESS - Science and Technology Publications. https://doi.org/10.5220/0006472900520060

Peng, J., He, F., Zhang, Y., Liu, Q., Miao, D., & Xiao, W. (2013). Differences in simulated doctor and patient medical decision making: A construal level perspective. *PloS One*, *8*(11). https://doi.org/10.1371/journal.pone.0079181

Pronin, E., Olivola, C. Y., & Kennedy, K. A. (2008). Doing unto future selves as you would do unto others: Psychological distance and decision making. *Personality & Social Psychology Bulletin*, *34*(2), 224–236. https://doi.org/10.1177/0146167207310023

Qu, W., Sun, H., & Ge, Y. (2021). The effects of trait anxiety and the big five personality traits on self-driving car acceptance. *Transportation*, *48*(5), 2663–2679. https://doi.org/10.1007/s11116-020-10143-7

Rasch, B., Friese, M., & Hofmann, W. (2021). *Quantitative Methoden* (5. Auflage). Springer. https://doi.org/10.1007/978-3-662-63284-0

Reczek, R. W., Trudel, R., & White, K. (2018). Focusing on the forest or the trees: How abstract versus concrete construal level predicts responses to eco-friendly products. *Journal of Environmental Psychology*, *57*, 87–98. https://doi.org/10.1016/j.jenvp.2018.06.003

Redman, L., Friman, M., Gärling, T., & Hartig, T. (2013). Quality attributes of public transport that attract car users: A research review. *Transport Policy*, *25*, 119–127. https://doi.org/10.1016/j.tranpol.2012.11.005

Sagristano, M. D., Trope, Y., & Liberman, N. (2002). Time-dependent gambling: Odds now, money later. *Journal of Experimental Psychology: General*, *131*(3), 364–376. https://doi.org/10.1037/0096-3445.131.3.364

Sauer, S. (2019). *Moderne Datenanalyse mit R: Daten einlesen, aufbereiten, visualisieren, modellieren und kommunizieren* (FOM-Edition). Springer Gabler. https://doi.org/10.1007/978-3-658-21587-3

Schandl, F., Fischer, P., & Hudecek, M. F. C. (2023). Predicting acceptance of autonomous shuttle buses by personality profiles: a latent profile analysis. *Transportation*. Advance online publication. https://doi.org/10.1007/s11116-023-10447-4

Schandl, F., & Hudecek, M. F. C. (2023). *Transportation by the Hand of a Ghost: The Influence of Trait Anxiety in the Context of Fear of giving up Control on the Acceptance of Autonomous Vehicles [Preprint]*. http://osf.io/7e9vc

Septianto, F., & Pratiwi, L. (2016). The moderating role of construal level on the evaluation of emotional appeal vs. cognitive appeal advertisements. *Marketing Letters*, *27*(1), 171–181. https://doi.org/10.1007/s11002-014-9324-z

Shapiro, S. S., & Wilk, M. B. (1965). An Analysis of Variance Test for Normality (Complete Samples). *Biometrika*, *52*(3/4), 591–611. https://doi.org/10.2307/2333709

Sharma, N., & Garg, R. D. (2022). Cost reduction for advanced driver assistance systems through hardware downscaling and deep learning. *Systems Engineering*, *25*(2), 133–143. https://doi.org/10.1002/sys.21606

So, D., Sladek, R., & Joly, Y. (2021). Assessing public opinions on the likelihood and permissibility of gene editing through construal level theory. *New Genetics and Society*, *40*(4), 473–497. https://doi.org/10.1080/14636778.2020.1868985

Stojic, D., Ciric, Z., Sedlak, O., & Marcikic Horvat, A. (2020). Students' Views on Public Transport: Satisfaction and Emission. *Sustainability*, *12*(20), 8470. https://doi.org/10.3390/su12208470

Trope, Y., & Liberman, N. (2003a). Temporal construal. *Psychological Review*, *110*(3), 403–421. https://doi.org/10.1037/0033-295X.110.3.403

Trope, Y., & Liberman, N. (2003b). Temporal construal theory of time-dependent preferences. In I. Brocas & J. D. Carrillo (Eds.), *The psychology of economic decisions: Vol. 1. Rationality and Well-Being* (pp. 235–249). Oxford University Press. https://doi.org/10.1093/oso/9780199251063.003.0012

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review*, *117*(2), 40–463. https://doi.org/10.1037/a0018963

Trope, Y., Liberman, N., & Wakslak, C. (2007). Construal Levels and Psychological Distance: Effects on Representation, Prediction, Evaluation, and Behavior. *Journal of Consumer Psychology*, *17*(2), 83–95. https://doi.org/10.1016/S1057-7408(07)70013-X

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, *36*(1), 157–178. https://doi.org/10.2307/41410412

Vos, J. de, Waygood, E. O. D., & Letarte, L. (2020). Modeling the desire for using public transport. *Travel Behaviour and Society*, *19*, 90–98. https://doi.org/10.1016/j.tbs.2019.12.005

Weyrich, P., Scolobig, A., Walther, F., & Patt, A. (2020). Do intentions indicate actual behaviour? A comparison between scenario-based experiments and real-time observations of warning response. *Journal of Contingencies and Crisis Management*, *28*(3), 240–250. https://doi.org/10.1111/1468-5973.12318

Wiegand, G., Eiband, M., Haubelt, M., & Hussmann, H. (2020). "I'd like an Explanation for That!"Exploring Reactions to Unexpected Autonomous Driving. In *ACM Digital Library, 22nd International Conference on Human-Computer Interaction with Mobile Devices and Services* (pp. 1–11). Association for Computing Machinery. https://doi.org/10.1145/3379503.3403554

Williams, L. E., & Bargh, J. A. (2008). Keeping one's distance: The influence of spatial distance cues on affect and evaluation. *Psychological Science*, *19*(3), 302–308. https://doi.org/10.1111/j.1467-9280.2008.02084.x

Xu, J.-Z., & Xie, X.-F. (2012). Self-Other Decision Making Difference: A Construal Level Perspective. *Acta Psychologica Sinica*, *43*(1), 11–20. https://doi.org/10.3724/SP.J.1041.2011.00011

Xu, Z., Zhang, K., Min, H., Wang, Z., Zhao, X., & Liu, P. (2018). What drives people to accept automated vehicles? Findings from a field experiment. *Transportation Research Part C: Emerging Technologies*, *95*, 320–334. https://doi.org/10.1016/j.trc.2018.07.024

Zhang, R., Kang, H., Jiang, Z., & Niu, X. (2023). How does workplace ostracism hurt employee creativity? Thriving at work as a mediator and organization-based self-esteem as a moderator. *Applied Psychology*, *72*(1), 211–230. https://doi.org/10.1111/apps.12374

Zinbarg, R. E., Revelle, W., Yovel, I., & Li, W. (2005). Cronbach's α, Revelle's β, and Mcdonald's ωH: Their relations with each other and two alternative conceptualizations of reliability. *Psychometrika*, *70*(1), 123–133. https://doi.org/10.1007/s11336-003-0974-7

Zmud, J., Sener, I. N., & Wagner, J. (2016). *Consumer acceptance and travel behavior: Impacts of automated vehicles: Final report*. Texas A&M Transportation Institute. https://rosap.ntl.bts.gov/view/dot/32687

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