

# Decoding the Language of Care: A Typology of Caregiver Utterances and Their Influence on Assistive Technology Use

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**Abstract:** Amid a global caregiver shortage and a growing reliance on assistive technology, this research investigates the intricate interactions between caregivers and care recipients in elder care settings, primarily focusing on caregivers' verbal utterances and the conditions under which these exchanges occur. Drawing on Weiner's causal attribution theory, we developed a typology of caregiver utterances that prompt shifts in care recipients' attributions during the use of assistive technology. This typology—comprised of 'praise', 'affirmation/acceptance', 'confirmation', and 'feedback' categories—illuminates key links between caregiver communication strategies and care recipients' perception shifts. Notably, 'confirmation' utterances tend to align with attributions to 'ability', whereas 'feedback' utterances correspond more closely with 'effort'. Our analysis of temporal fluctuations revealed significant changes in the frequency of these utterances throughout various stages of assistive technology usage. By offering a holistic understanding of these complex dynamics, this study seeks to shape the development of more effective caregiver communication strategies. Such enhancements are pivotal to optimize care recipients' experiences and engagement with assistive technology, thus addressing the ongoing caregiver deficit. Future research endeavors will expand our dataset and examine the potential generalizability of our findings to other caregiving environments.


## 1 INTRODUCTION


The global decline in birth-rates and an increasingly aging population have resulted in a pressing shortage of caregivers in many parts of the world. To maintain the physical, mental, and social well-being of elderly individuals requiring care, fostering their active participation in society is important.


Zallio & Ohashi (2022) mention that assistive technology has become a pivotal tool in this setting. Such technologies not only support elderly care recipients in physical activities but also provide a crucial platform for meaningful interaction between caregivers and care recipients. Effective communication within these interactions can significantly shape the emotional and motivational states of the care recipients.

However, it is still unclear as to which verbal interventions prove most influential during the usage of assistive technology. While previous studies such as those by Zolnierek et al. (2009) and Street (2013) have emphasized the impact of healthcare provider communication on patient outcomes, these studies often overlook the specific dynamics of communication during assistive technology use.

In this regard, Weiner's et al. (1989) causal attribution theory offers a substantial contribution to our understanding. This theory is a cornerstone in the study of human motivation and suggests that individuals interpret and predict the outcomes of achievement tasks using four elements of attribution: 'ability', 'effort', 'task difficulty', and 'luck'. This theory posits that these attributions significantly influence the way individuals react to successes or

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failures, affecting their emotions, motivations, and future performance.

In healthcare, Palmieri et al. (2009) explored the applicability of attribution theory, illuminating how healthcare providers' communication methods influence patients' perceptions and behaviors. Similarly, Ohashi et al. (2021) applied causal attribution theory in social services, focusing on interactions between caregivers and elderly patients using an electrically assisted four-wheel cycle, a form of assistive technology. The aim was to detect emotional and motivational fluctuations in care recipients during tasks to estimate attributions for each utterance. However, existing studies primarily focus on caregivers or care recipients individually, neglecting the interaction between them.

This study endeavors to elucidate the interactions between caregivers and care recipients, namely, how the utterances of caregivers impact the willingness of care recipients to use assistive technology. Figure 1 represents the conceptual framework of this study. To clarify the interaction between both parties, we utilized the user experience (UX) framework by Hassenzahl & Tractinsky (2006). They stated, “UX is the result of a user’s internal state (traits, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (complexity, purpose, usability, functionality, etc.), and the context (or environment) within which the interaction occurs (organizational/social setting, meaningfulness of the activity, voluntariness of use, etc.)” The framework offers a comprehensive approach to understanding the interaction between technical systems and users, providing a solid foundation for grasping the relationship between caregivers' utterances, the state of care recipients, and involvement with assistive technology.

We extended the elements of “internal state,” “context,” and “system characteristics” in the framework as follows: The state of the care recipient is positioned as the “internal state.” The “internal state” of the care recipient indicates motivations and moods, and applying the attribution theory to this is important. The attribution theory is a framework that explores how individuals interpret and attribute causes to outcomes. By utilizing this, it is possible to intricately analyze how the utterances of caregivers affect the psychological state of care recipients, particularly influencing motivations and the willingness to use assistive technology. We situated caregivers' utterances within “context.” The utterances affect the state of care recipients, significantly influencing how care recipients experience assistive technology. Thus, these

utterances correspond to the overall situation or environment in which a specific UX is formed. The electrically assisted four-wheel cycle used in this study was categorized under “system characteristics,” with its features being influenced by usability and functionality.

The objective of this study is to focus on the communication between caregivers and care recipients within the UX framework, clarifying their interaction from the perspective of attribution theory. To this end, the following steps were undertaken.

(i) To create a classification system or “typology” for the different utterances caregivers use that influence how care recipients attribute their actions while using assistive technology.

(ii) To investigate how this typology is related to changes in the care recipients' attributions, meaning how the recipients understand and explain their own behavior.

(iii) To study which types of utterances cause shifts in these attributions and examine how the effects of these utterances change over time. Here, “temporal fluctuations” simply refers to these changes or shifts over time.

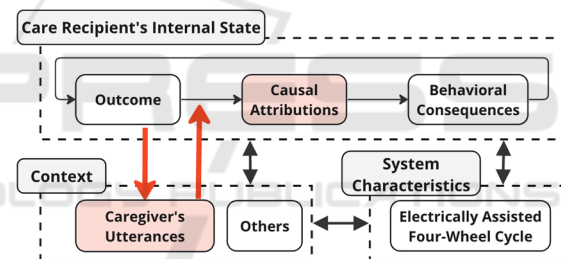


Figure 1: Conceptual framework of this study.

## 2 RESEARCH METHODOLOGY

### 2.1 Study Design

To achieve our first objective—constructing a typology of caregivers' utterances that influence care recipients' attribution shifts—we utilized Otani's (2011) qualitative Steps for Coding and Theorization (SCAT) method. This method is well-suited for the nuanced analysis of relatively small data sets, allowing us to isolate and categorize impactful caregiver utterances during assistive technology usage. For our second objective—examining the relationship between the constructed utterance typology and changes in care recipients' attributions—we employed quantitative analysis techniques. This provided statistical insights into how changes in caregiver communication related with

Table 1: An exemplar of the analytical procedure for Steps for Coding and Theorization (SCAT).

No.	Speaker	Text	(1) Focused words from within the text	(2) Words outside of the text that are replaceable with the words from (1)	(3) Words which explain the words in (1) and (2)	(4) Themes and constructs
36	Care recipient	Heavy. It's heavy. It's heavy.	Heavy, It's heavy	Body, High load	Pedal operation, Physical load, Mention	Mention of physical load
37	Care giver	Yeah?	Yeah, ?	Affirmation, Confirmation	Equipment operation, Dissatisfaction	Confirmation of condition
38	Care recipient	You're not doing it right, are you?	You're not doing it right, are you?	Manipulation, Evaluation, Self-responsibility	Equipment Operation, Method, Search for cause	Search for causes of physical load
39	Care giver	Yeah. It starts a little, you know, with a little resistance, so it might be heavy.	Yeah, It starts a little, A little resistance, It might be heavy	Guess, Initial movement, Resistance, Body, high load	Assistive technology, Initial resistance, Search for cause, Clarification	Suggestion of the cause to the initial operation of the equipment
40	Care recipient	This is not going to work with Silver.	This is not going to work with Silver	Initial movement, High load, Elderly, Manipulation, Difficulty	Elderly person, Pedaling, Difficulty, Suggestion	Suggestion of difficulty in operation by the frail elderly

shifts in care recipient attributions. Finally, to address our third objective—exploring the typologies of utterances that induce shifts in attributions and analyzing their temporal fluctuations—we employed a comparative analysis of earlier and later interactions. This allowed us to ascertain potential variations in the influence of different utterances as the caregiving interaction unfolds.

## 2.2 Studied Data

The data for this study were drawn from Ohashi et al.'s (2021) research on interactions between elderly participants using assistive technology and aides. In this paper, "caregiver" refers to non-professional individuals facilitating task progression rather than providing care; we use "care recipient" for those receiving support. Interactions occurred during a predetermined course using an electrically assisted four-wheel cycle for about 15 minutes. We utilized a subset of their dataset, totaling 2514 utterances, collected from two sessions of three unique pairings (pairs A, B, and C), with each session indicated by a respective number (e.g., A-1). To avoid influence from existing relationships, each pairing involved individuals interacting for the first time. Conversations were recorded via a camera attached to the technology and an additional handheld camera. Utterances were chronologically segmented, and, aligning with Ohashi et al.'s (2021) rules, divided into

four classifications, stemming from Weiner et al.'s (1989) attribution theory: 'ability', 'effort', 'task difficulty', and 'luck'.

## 2.3 Data Analysis

The particular procedures (1-5) used in our study are outlined below:

(1) Utilizing the SCAT method, we conceptualized all utterances from both caregivers and care recipients. This process entailed identifying phrases of interest, paraphrasing them, explicating their meaning, and forming emergent concepts and themes (Table 1).

(2) In order to identify if a caregiver's utterance induced an attribution shift, we first singled out the utterance made by the caregiver immediately before the shift. Considering the context derived from the storyline described by SCAT, we determined whether the caregiver's utterance had the potential to impact the attribution shift.

(3) The process for typifying caregiver utterances that facilitate attribution shifts in care recipients involved extracting the SCAT-derived themes and constructs that were judged in step (2) to have potentially triggered an attribution shift. We executed a three-stage abstraction process, encompassing sub-typologies, sub-typologies, and typologies for

these conceptual frameworks to formulate the typology.

4) The analysis of the relationship between attribution shifts and utterance typologies involved counting the number of shifts incited by each typology. This provided us with a quantitative means to examine tendencies in both caregiver utterances and care recipient attributions.

(5) To scrutinize the connection between the utterance typologies and the temporal progression of interactions, we numerically assigned utterances and computed their ratio within total utterances. Values less than 0.51 were considered as belonging to the first half of the interaction, and values of 0.51 or higher were treated as belonging to the latter half. We calculated the frequency of typologies that could potentially trigger attribution shifts in both halves, thereby gaining insights into not only the evolution of caregivers' linguistic strategies over time but also the varying responsiveness of care recipients.

### 3 RESULTS

#### 3.1 Utterance Typologies of Caregivers

Findings from procedures (1) to (3) unveiled distinct patterns in caregiver utterances. Out of 1,474 utterances made by caregivers, 309 were singled out as potential instigators for attribution shifts in care recipients. We classified these utterances into four categories as outlined by the SCAT framework: 'praise', 'affirmation/acceptance', 'confirmation', and

'feedback' (Table 2). 'Praise' includes utterances that laud or amplify the recipients' skills or attitudes. 'Affirmation/acceptance' encapsulates utterances that recognize or empathize with the recipients' abilities or attitudes during the use of the assistive technology. 'Confirmation' contains utterances that confirm essential skills, attitudes, or identify challenges. Lastly, 'feedback' consists of utterances that provide guidance on device operation or stimulate attitude changes.

These findings underscore the diverse communication strategies utilized by caregivers, and spotlight various linguistic cues that might sway the attribution perceptions of recipient.

#### 3.2 Relationship Between Attribution Shift and Utterance Typology

Table 3 illustrates the identified typologies and quantifies the instances where caregiver utterances instigated attribution shifts. To further understand the relationship between attribution shifts and utterance typologies, we utilized the Monte Carlo estimation. This is an unbiased technique that estimates exact significance levels by repeatedly sampling from a reference set of tables, which share the same dimensions and row and column margins as the observed table. According to IBM Corporation (2021), it allows estimation of exact significance without relying on the assumptions needed for the asymptotic method, which is especially beneficial when the dataset is too large for exact computations or fails to meet the assumptions of the asymptotic method.

Table 2: Typologies and number of caregiver utterances extracted.

Typologies	Sub-typologies	Examples of caregiver utterance	Number of utterances
Praise	Praise of skills	The button controls are good, aren't they?	5
Affirmation/ Acceptance	Affirmation of attitude	Oh, yes. Thank you for your hard work.	49
	Affirmation of skills	Ah, yes, yes, that's right.	
Confirmation	Confirmation of attitude	Are you okay?	60
	Confirmation of skills	Are your legs getting tired?	
	Confirmation of problems	Is it set to low speed? Is it fast?	
Feedback	Encouraging attitude change	You're getting used to it.	195
	Guidance for task accomplishment	Next time, it's better to make a wider turn.	

Through the Monte Carlo estimation with 10,000 samplings, we discovered a significant deviation between the observed frequencies of attribution shifts for each utterance typology and their expected values (Monte Carlo  $p < .001$ ). Additionally, we conducted post hoc tests using the Bonferroni multiple comparisons method, and their results are incorporated into Table 3. In our findings, within the 'confirmation' typology, 25 of the 60 utterances prompted shifts towards an 'ability' attribution, representing approximately 41.6%. Similarly, within the 'feedback' typology, 82 out of 195 utterances triggered shifts towards an 'effort' attribution, accounting for around 42.1%. These findings emphasize the complex interaction between the types of caregiver utterances and the direction of attribution shifts in care recipients. Specifically, when the utterance typology is 'confirmation', there is a significant tendency towards 'ability' attribution, and when it is 'feedback', there is a clear inclination towards 'effort' attribution.

Table 3: Interrelation between the utterance typologies and the attribution shift.

	Effort	Ability	Luck	Task	Total
<b>Praise</b>	1a	0a	2a	2a	5
<b>Affirmation /Acceptance</b>	15a	8a	11a	15a	49
<b>Confirmation</b>	10a	25b	10a,b	15a	60
<b>Feedback</b>	82a	31b	41b	41a,b	195
<b>Total</b>	108	64	64	73	309

Note: Different letters indicate significant differences at  $p < .05$ .

The following excerpt illustrates a 'confirmation' typology of utterance that encourages a shift towards 'ability' attribution. The context involves a care recipient expressing concern about the height of the seat when trying out an assistive technology.

Excerpt A-2:

Turn No. [Speaker] Utterance.

7. [Care recipient] *Alright, here I go, I'm getting on.*

12. [Caregiver] *Seems like the pedal is too low to cycle. This isn't quite right.*

13. [Care recipient] *This is fine for me.*

While the caregiver is making observations to confirm the condition of the equipment, remarking, "seems like the pedal is too low to cycle," the care recipient appears to be compromising, asserting, "This is fine for me." This suggests that the care

recipient is attributing the cause to their own 'capability.'

Below is an example of the 'feedback' typology of utterances, which encourages a shift in attribution towards 'effort'. This instance occurs when the care recipient expresses unease regarding the operation of the equipment.

Excerpt A-1:

133. [Care recipient] *I'm a bit scared, it's leaning to the side.*

134. [Caregiver] *Just a bit more, this way, this way.*

135. [Care recipient] *Oh...*

136. [Caregiver] *Wide turn. Wide turn. Make a wide turn this way.*

137. [Care recipient] *Wide turn.*

138. [Caregiver] *Yes.*

In response to the caregiver's instruction on the handling of the equipment, "Wide turn. Wide turn. Make a wide turn this way," the care recipient exhibits understanding by repeating the direction, "Wide turn." This instance clearly demonstrates the care recipient's effort to overcome the apprehension related to the operation of the assistive technology, prompted by the caregiver's instructive feedback. This interaction suggests a transition in causal attribution towards 'effort'.

### 3.3 Temporal Fluctuation of Effect of Utterance Typology on Attribution Shift

Table 4 demonstrates the distribution of utterance typologies throughout the progression of the interaction. To delve deeper into the relationship between utterance typologies and their temporal progression, we utilized the Fisher-Freeman-Halton exact test on the data presented in Table 4. The analysis unveiled a significant difference between the observed and expected distributions over time for each utterance typology ( $p < .001$ ). We also synthesized the findings from post hoc tests, using Bonferroni's multiple comparison method, into the same table. This data synthesis suggests that 'affirmation/acceptance' utterances are more likely to appear in the latter half of the progression, while 'confirmation' utterances are predominantly observed in the first half.

As in Table 4, 'affirmation/acceptance', consisting of 49 utterances, predominantly appears in the 'latter half' of the interaction, comprising approximately 60% of the utterances. In contrast, 'confirmation', totaling 60 utterances, is primarily observed in the



'first half' of the interaction, accounting for about 75%. These observations elucidate a discernible pattern between the occurrence of utterance typologies and their placement within the temporal progression.

Table 4: Number of caregiver utterance typologies in the first and latter halves of the trial ride.

	First half	Latter half	Total
<b>Praise</b>	1a	4a	5
<b>Affirmation /Acceptance</b>	21b	28a	49
<b>Confirmation</b>	45b	15a	60
<b>Feedback</b>	109a	86a	195
<b>Total</b>	176	133	309

Note: Different letters indicate significant differences at  $p < .05$ .

## 4 DISCUSSIONS

### 4.1 Interplay Between Attribution Shift and Utterance Typologies

This study delved into the complex relationship between the caregiver's utterance typologies and the care recipient's attribution shifts amidst the usage of assistive technology. The principal findings underscore two salient relationships: 'confirmation' utterances from caregivers commonly lead care recipients to attribute their actions to 'ability'. In contrast, 'feedback' utterances result in care recipients attributing their actions to 'effort'.

These findings align with the pedagogical models proposed by Bangert-Drowns et al. (1991) and Shute (2008). The model by Bangert-Drowns et al. outlines that learners experience a sequence of stages, from advice reception to performance adjustment, based on their own evaluation. In this framework, a caregiver's advice may act as a catalyst, prompting the care recipient to re-evaluate their performance and adjust their actions accordingly. Shute's research further emphasizes the importance of feedback tailored to the learner's state, which includes task simplification, goal adjustment, and the reinforcement of correct methods. When applied to the caregiving context, a caregiver's feedback might modulate a care recipient's motivation, interest, goals, and knowledge, thereby instigating changes in their behavioral state.

Building on prior research, our study offers novel insights into the influence of caregiver utterances on care recipients' assistive technology usage.

Specifically, 'confirmation' utterances, which often involve checking the care recipient's equipment operation and their physical and mental state, seem to bolster the care recipient's acknowledgement of their own ability. As a result, care recipients are more likely to attribute their actions to 'ability'.

Similarly, 'feedback' utterances, typically offering guidance on equipment operation and attitude improvement, can heighten care recipients' awareness of their goal achievement progress. This heightened awareness often prompts an increased effort from care recipients, making them more likely to attribute their actions to 'effort'.

By pinpointing these specific utterance-attribution relationships, our study enhances the understanding of the interplay between caregiver communication strategies and care recipients' perceptions and utilization of assistive technology.

### 4.2 Relationship Between Utterance Typologies and Temporal Fluctuation

The care recipient's test ride time was divided into the first and latter half, and the trends in utterance typologies were analyzed from a temporal fluctuation perspective. The results showed that the utterance typologies 'affirmation/acceptance' was significantly more prevalent in the latter half of the test ride, while the typology of utterances 'confirmation' was significantly more prevalent in the first half.

Two potential influences may account for the noticeable discrepancy in the timing of utterances prompting attribution shifts. The first is the potential transformation in the caregivers' utterances between the first and latter halves of the period. The second is the possible alteration in the care recipients' state, specifically, their responsiveness.

To discuss the potential shift in the caregiver's utterances over time, actual examples of utterances are provided. The utterance example below is from a scene where the care recipient, seen near the first half of the test ride, is commenting on the strain on their legs concerning the operation of the four-wheel cycle with electric assist.

Excerpt A-1:

224. [Care recipient] *This is heavy.*

225. [Caregiver] *It's heavy, is it? Well, you can pedal a bit faster then.*

226. [Care recipient] *Okay, I'll pedal faster. It's pointless otherwise.*

In response to the care recipient's remark, the caregiver directs the locus of causality toward the

care recipient himself, suggesting “Well, you can pedal a bit faster then.” In response, the care recipient attributes the causality to the 'task difficulty', asserting, “It's pointless otherwise.”

The following presents an analogous scene occurring in the latter half of the same pair's trial.

Excerpt A-1:

281. [Care recipient] *But, this is rather overwhelming. It's heavy and feels like it's moving at high speed.*

286. [Caregiver] *Hmm, I wonder what could be the reason. Maybe we should ask someone from Yamaha.*

287. [Care recipient] *(Laughs)*

In a similar situation, in response to the care recipient's remarks, “overwhelming” and “heavy,” the caregiver shifts the attribution of the cause to the assistive technology, suggesting, “Maybe we should ask someone from Yamaha” (Yamaha: Manufacturing company name). This statement directs the cause of the problem not to the care recipient himself, but to external factors such as the environment or equipment. The care recipient responds with a smile, inferring a shift in attribution of the cause towards 'luck'. Thus, by altering the method or trend of their linguistic interventions between the initial and latter stages of the trial ride, caregivers may have instigated different shifts in the care recipients' attributions, even under similar scenarios. This could be one potential explanation for the observed temporal shift in the occurrence of specific types of caregiver utterances that trigger attribution shifts.

Next, in terms of the latter possibility, that the care recipient's state, namely their responsiveness, shifted in the first and latter half of the ride, an explanation is provided with actual examples of conversation. The following utterance is an example observed in the first half of the ride, where the care recipient feels anxious about operating the assistive technology.

Excerpt C-1:

212. [Care recipient] *I'd feel terrible if I were to damage anything here.*

213. [Caregiver] *No, no, you're all right. You're absolutely fine.*

215. [Care recipient] *That won't do.*

216. [Care recipient] *Indeed, you're okay.*

218. [Caregiver] *I'm sorry, but I may not be able to do this. I feel bad for causing everyone inconvenience.*

219. [Care recipient] *You're entirely fine, truly.*

221. [Care recipient] *This, this part is... it's not going well at all.*

In response to the care recipient's expression of apprehension about operating the device, conveyed through their words, “I'd feel terrible if I were to damage anything here,” the caregiver seeks to reassure by assuring them, “you're all right.” Contrarily, the care recipient exhibits a negative reaction towards operating the device, stating, “I may not be able to do this,” and “it's not going well at all”. This indicates that the care recipient's attribution is directed towards their own abilities.

A subsequent example from a similar situation in the latter part of the ride with the same pair is presented.

Excerpt C-1:

545. [Care recipient] *No, it wouldn't be good if it gets damaged. Just a bit more.*

546. [Caregiver] *It's okay, it's okay. You're doing fine.*

547. [Care recipient] *Is it okay?*

548. [Caregiver] *Yes, it's perfectly fine.*

551. [Care recipient] *Ah, it's hitting. Is it not hitting?*

552. [Caregiver] *Yes, everything is fine.*

555. [Care recipient] *So, like this.*

In response to the care recipient's apprehension about potentially damaging the equipment, expressed with phrases such as “it wouldn't be good if it gets damaged,” the caregiver alleviates the concern by affirmatively stating “you're doing fine.” Consequently, the care recipient exhibits a greater commitment to the operation of the device through proactive queries like “Is it not hitting?” and assertive declarations such as “So, like this.” This behavior indicates a shift in attribution towards their own effort.

Hence, it can be surmised that the temporal transition occurring within the trial duration, despite similar situations and identical linguistic interventions from the caregiver, is driven by a transformation in the care recipient's reactive state. This transformation could potentially explain the observed changes in the frequency of caregiver utterances that promote attribution shifts.

## 5 CONCLUSIONS

The aim of this study is to focus on the communication between caregivers and care recipients within the UX framework and to elucidate their interactions from the perspective of attribution theory. By deepening the understanding of these dynamics, we can promote more effective verbal interventions by caregivers and encourage more

productive use of assistive technology by care recipients.

In alignment with Weiner's causal attribution theory, we constructed a typology of caregivers' utterances that influence care recipients' attribution shifts during the use of assistive technology. We delineated four main categories of utterances: 'praise', 'affirmation/acceptance', 'confirmation', and 'feedback'. Our analysis revealed that 'confirmation' utterances were frequently associated with attributions to 'ability', while 'feedback' utterances were more often linked with 'effort'. These findings suggest that caregivers adapt their language to guide shifts in care recipients' attributions, tailoring their responses to different situations.

Our temporal fluctuation analysis demonstrated a significant difference in the frequency of 'affirmation/acceptance' and 'confirmation' utterances between the initial and later stages of assistive technology usage. This shift may reflect changes in caregivers' verbal strategies and the care recipients' responses over time.

The study acknowledges its limitations, such as the need for a larger and more diverse dataset to permit a comprehensive understanding of the relationships among attribution, utterance categories, and temporal fluctuation data. Future research will focus on expanding our dataset and investigating whether these utterance typologies and shifts in causality perception can be applied to other caregiving contexts. Additionally, to verify the validity of the findings of this study, obtaining feedback from either caregivers or care recipients is considered as a subsequent step.

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## REFERENCES

- Zallio, M., & Ohashi, T. (2022). The Evolution of Assistive Technology: A Literature Review of Technology Developments and Applications. *AHFE Open Access*, vol 37, 85-93. <http://doi.org/10.54941/ahfe1001646>
- Haskard Zolnierok, K. B., & DiMatteo, M. R. (2009). Physician Communication and Patient Adherence to Treatment: A Meta-Analysis. *Medical Care*, 47(8), 826–834. <https://doi.org/10.1097/MLR.0b013e31819a5acc>
- Street, R. L. (2013). How clinician–patient communication contributes to health improvement: Modeling pathways from talk to outcome. *Patient Education and Counseling*, 92(3), 286–291. <https://doi.org/10.1016/j.pec.2013.05.004>
- Schuster, B., Forsterlung, F., & Weiner, B. (1989). Perceiving the Causes of Success and Failure: A Cross-Cultural Examination of Attributional Concepts. *Journal of Cross-Cultural Psychology*, 20(2), 191–213. <https://doi.org/10.1177/0022022189202005>
- Palmieri, P. A., & Peterson, L. T. (2009). Attribution theory and healthcare culture: Translational management science contributes a framework to identify the etiology of punitive clinical environments. In G. T. Savage & M. D. Fottler (Eds.), *Advances in Health Care Management* (Vol. 8, pp. 81–111). Emerald Group Publishing Limited. [https://doi.org/10.1108/S1474-8231\(2009\)0000008008](https://doi.org/10.1108/S1474-8231(2009)0000008008)
- Ohashi, T., Watanabe, M., Takenaka, Y., & Saijo, M. (2021). Real-Time Assessment of Causal Attribution Shift and Stay Between Two Successive Tests of Movement Aids. *Integrative Psychological and Behavioral Science*, 55(3), 541–565. <https://doi.org/10.1007/s12124-020-09592-7>
- Hassenzahl, M., & Tractinsky, N. (2006). User experience—A research agenda. *Behaviour & Information Technology*, 25(2), 91–97. <https://doi.org/10.1080/01449290500330331>
- Otani, T. (2011). “SCAT” A Qualitative Data Analysis Method by Four-Step Coding : Easy Startable and Small Scale Data-Applicable Process of Theorization. *Bulletin of the Graduate School of Education and Human Development. Educational Sciences*, 54(2), 27-44. <https://doi.org/10.18999/nueduca.54.2.27>
- IBM Corporation. (2021). Exact Tests. In SPSS Statistics 25.0 Documentation. IBM Documentation. Retrieved July 24, 2023, from <https://www.ibm.com/docs/en/spss-statistics/25.0.0?topic=tests-exact>
- Bangert-Drowns, R. L., Kulik, C.-L. C., Kulik, J. A., & Morgan, M. (1991). The Instructional Effect of Feedback in Test-Like Events. *Review of Educational Research*, 61(2), 213–238. <https://doi.org/10.3102/00346543061002213>
- Shute, V. J. (2008). Focus on Formative Feedback. *Review of Educational Research*, 78(1), 153–189. <https://doi.org/10.3102/0034654307313795>