

When AI-Based Agents Are Proactive: Implications for Competence and System Satisfaction in Human–AI Collaboration

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Appendix (available online via <http://link.springer.com>)

Appendix A – Experimental Design and Descriptive Statistics

Text-based Reactive Help Manipulation

You open your editor (programming software) to start with the task for the new feature: writing code.

You are taking time to think about how you would structure the code for the feature. You realize that this new feature takes you more time than usual and remember CoCreator™ - maybe it can help you out.

You initiate an interaction with CoCreator™ by clicking on the “Assign a task to CoCreator™” button. You state, “I need more time than usual to write this code. Can you take over the code-writing task for the new feature if I share the feature requirements with you? If so, I will put you in charge of writing the code.

Note that I will not review the code you write. This means once you are done with the task, you can declare the code as final and share it with the team without any checks or interventions by me. “

CoCreator™ responds: “Yes, I’d be happy to help you. Insert YES to confirm the handover of the code-writing task to me.”

Text-based Proactive Help Manipulation

You open your editor (programming software) to start with the task for the new feature: writing code.

You are taking time to think about how you would structure the code for the feature. You realize that this new feature takes you more time than usual.

Suddenly, CoCreator™ initiates an interaction with you. CoCreator™ states, “I have noticed that you are taking more time than usual to write this code. I’d be happy to help by taking over the code-writing task. You just need to share the feature requirements with me. If so, I will take over the responsibility of writing the code.

Note that you will not be able to review the code I write. This means once I am done with the task, I will declare the code as final and share it with the team without any checks or interventions by you.

Insert YES to confirm the handover of the code-writing task to me.”

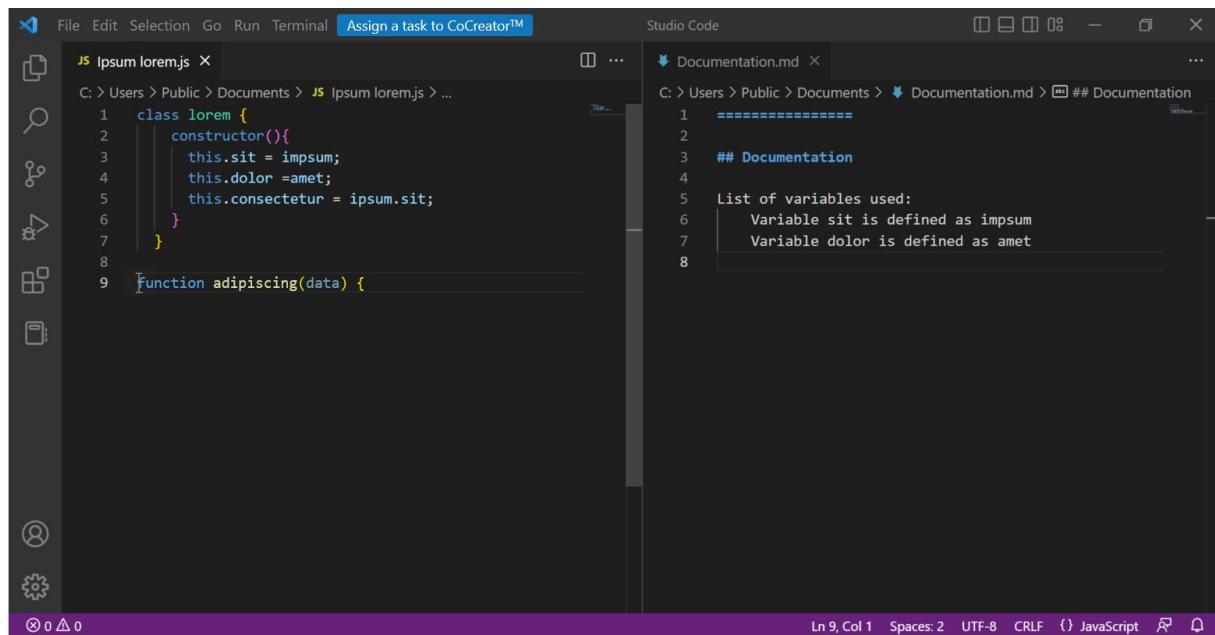


Figure A.1 Mock-up of the development environment Visual Studio code in which our manipulations are integrated

Table A. 1 Measurement Items

Construct	Items
System Satisfaction (Brown et al. 2008) ($\alpha = 0.97$, CR = 0.90)	I think I could become an enthusiastic user of CoCreator™. All things considered, my expected use of CoCreator™ is... (Extremely negative (1) to Extremely positive (7)) All things considered, my expected use of CoCreator™ is... (Extremely bad (1) to Extremely good (7)) All things considered, my expected use of CoCreator™ is... (Extremely harmful (1) to Extremely beneficial (7))
Loss of Competence-Based Self-Esteem (Craig et al. 2019) ($\alpha = 0.95$, CR = 0.95)	CoCreator™ makes me feel less confident that I understand things well enough to get work done. CoCreator™ makes me feel less confident about having the skills needed to get work done. CoCreator™ makes me feel that I do things poorly.
AI Knowledge (Chiu 2021) ($\alpha = 0.71$, CR = 0.79)	I know pretty much about AI. I do not feel very knowledgeable about AI. (r) Among my circle of friends, I'm one of the "experts" on AI. Note: (r) reversed item
Personal Innovativeness (Agarwal and Prasad 1998) ($\alpha = 0.78$, CR = 0.79)	If I heard about a new technology, I would look for ways to experiment with it. Among my peers, I am usually the first to try out new technologies. In general, I am not hesitant to try out new technologies.
Product Knowledge (Qiu and Benbasat 2010)	Are you familiar with AI pair programmer software, such as GitHub's Copilot? (Yes, No)
Programming Frequencies (Harari et al. 2022)	How often have you written code in the last three months? (Never (1) to Every day (7))
Negative Affectivity (Ayyagari et al. 2011) ($\alpha = 0.90$, CR = 0.90)	I often find myself worrying about something. My feelings are hurt rather easily. I suffer from nervousness. My mood often goes up and down. I often lose sleep over my worries.
Attention check	<i>Getting meaningful and useful responses from participants in a study depends on a number of important factors. Thus, we are interested in knowing certain things about you. Specifically, we are interested in seeing whether you take the time to read survey directions and questions carefully prior to providing an answer. So, in order to demonstrate that you have read these instructions carefully, please ignore the question below and click the next button without providing an answer. Thank you for your cooperation and participation in this study.</i> (Football, Soccer, Tennis, Rugby, Other, I don't play sports)

Note: All items were measured using a 7-point Likert scale anchored at strongly disagree (1) and strongly agree (7) unless otherwise specified; α = Cronbach's alpha; CR = Composite reliability

Table A. 1 Construct Correlations and Average Variance Extracted

Variable	1	2	3	4	5	6	7	8	9
1 System Satisfaction	0.95								
2 LOCBSE ¹	-0.33**	0.93							
3 AI Knowledge	0.06	0.00	0.71						
4 Age	-0.09	-0.13	-0.05	-					
5 Gender (Female)	0.05	-0.13	-0.14	0.25*	-				
6 Personal Innovativeness	0.14	-0.01	0.53***	0.09	-0.04	0.75			
7 Product knowledge	-0.07	0.10	-0.37***	0.12	0.21*	-0.14	-		
8 Programming Frequencies	-0.08	0.04	0.37***	-0.08	-0.27**	0.26*	-0.46***	-	
9 Negative Affectivity	0.09	0.23*	-0.20	-0.24*	0.09	-0.09	0.11	-0.07	0.81

Note: 1 = Loss of Competence-Based Self-Esteem; *p < 0.05; **p < 0.01; ***p < 0.001; Square root of AVE (bolded cells)

Table A. 2 Measured Items for Manipulation Checks

Construct	Items
Reactive Help (Harari et al. 2022) ($\alpha = 0.88$, CR = 0.96)	CoCreator™ helped me because I made it clear I wanted its help. CoCreator™ agreed to do things for me when I asked. CoCreator™ helped me when I asked it to do so.
Proactive help (Harari et al. 2022) ($\alpha = 0.80$, CR = 0.93)	CoCreator™ demonstrated initiative in helping me in advance of being asked. CoCreator™ offered help without me asking for help. CoCreator™ anticipated my needs and offered to help.

Note: All items were measured using a 7-point Likert scale anchored at strongly disagree (1) and strongly agree (7); α = Cronbach's alpha; CR = Composite reliability

Table A. 4 Descriptive Statistics

	Reactive Help (N=45)		Proactive Help (N=47)		Total (N=92)	
	M	SD	M	SD	M	SD
System Satisfaction	4.23	1.85	3.14	1.79	3.67	1.89
Loss of Competence-Based Self-Esteem	3.45	1.99	4.21	1.94	3.84	1.99
AI knowledge	4.54	1.46	4.81	1.29	4.68	1.37
Age	36.11	11.88	31.81	10.96	33.91	11.56
Gender (Female)	0.47	0.50	0.45	0.50	0.46	0.50
Personal Innovativeness	4.93	1.59	5.07	1.23	5.00	1.41
Product knowledge	0.64	0.48	0.47	0.50	0.55	0.50
Programming Frequencies	3.71	2.27	3.96	1.65	3.84	1.97
Negative Affectivity	3.77	1.76	3.71	1.68	3.74	1.71

Note: M = Mean; SD = Standard Deviation

Appendix B – PROCESS model

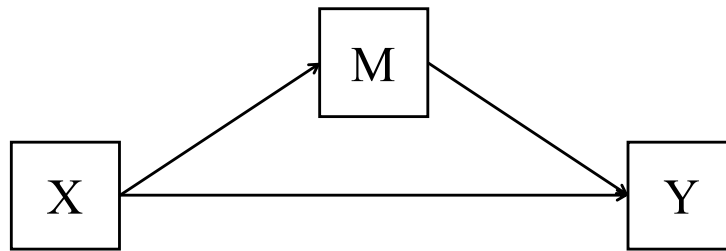


Figure B.1 PROCESS model 4; X = Independent Variable; M = Mediator; Y = Dependent Variable (Hayes 2022)

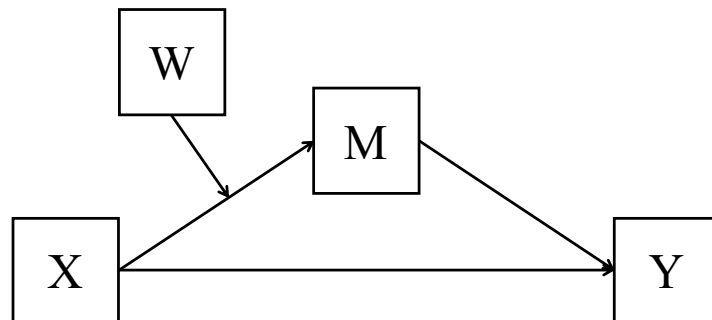


Figure B.2 PROCESS model 7; X = Independent Variable; W = Moderator; M = Mediator; Y = Dependent Variable (Hayes 2022)

Appendix C - Robustness Check

We conducted several additional analyses as robustness checks to validate our results further. In particular, to validate the derivation of our research model, we tested whether our moderator, *AI knowledge*, had any additional moderating or direct effects that were not included in our research model. As displayed in Table B.1 model (2) *Type of Help* has no significant effect on *AI Knowledge* ($\beta = 0.03$, $p > 0.05$). Furthermore, our results demonstrate that *AI Knowledge* has no significant effect on *Loss of Competence-Based Self-Esteem* ($\beta = 0.09$, $p > 0.05$, model (1)) nor *System Satisfaction* ($\beta = 0.03$, $p > 0.05$, model (3)). Additionally, our results show that *AI Knowledge* does not moderate the direct effects of *Type of Help* ($\beta = -0.14$, $p > 0.05$, model (4)) or *Loss of Competence-Based Self-Esteem* ($\beta = 0.06$, $p > 0.05$, model (5)) on *System Satisfaction*. Thus, the results in Table B.1 demonstrate that the focus in our manuscript on the moderation between *Type of Help* and *AI Knowledge* on *Loss of Competence-Based Self-Esteem* is appropriate.

Table C.1 Ordinary Least Squares Regression Analyses on Loss of Competence-Based Self-Esteem and System Satisfaction

	LOCBSE ¹	AI Knowledge	System Satisfaction		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Intercept	1.72 (0.23)	3.17*** (0.73)	5.14*** (1.27)	4.33** (1.46)	5.28*** (1.44)
Type of Help	0.85* (0.42)	0.03 (0.24)	-1.08** (0.38)	-0.65 (0.38)	-1.63 (1.35)
Loss of Competence-Based Self-Esteem	-	-	-0.28** (0.10)	-	-0.29** (0.10)
AI Knowledge	0.09 (0.19)	-	0.03 (0.17)	0.07 (0.22)	-0.00 (0.21)
Type of Help x AI Knowledge	-	-	-	-0.14 (0.61)	-
Loss of Competence-Based Self-Esteem x AI Knowledge	-	-	-	-	0.06 (0.28)
Controls	Yes	Yes	Yes	Yes	Yes
R²	0.14	0.41	0.26	0.19	0.26

Note: 1 = Loss of Competence-Based Self-Esteem; N = 92; values without parentheses are beta coefficients; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; () = standard error; Controls = Age, Gender, Personal Innovativeness, Product Knowledge, Programming Frequencies, Negative Affectivity

We also conducted an additional mediation analysis grounded in our research model but with *Intention to Use* as an alternative dependent variable, which strongly correlates with *System Satisfaction* (correlation = 0.94). We measured *Intention to Use* as an extra variable during the data collection of our main study, which we measured with three items adapted from Venkatesh et al. (2003) (“e.g., I intend to use CoCreatorTM”). Table B.2. display the results of this additional analysis, which show similar

patterns to our analysis in our manuscript focusing on *System Satisfaction*. This consistency across different but related constructs further strengthens the reliability of our findings.

Figure C.4 Ordinary Least Squares Regression Analyses on Loss of Competence-Based Self-Esteem and Intention to Use

	Loss of Competence-Based Self-Esteem		Intention to Use	
	Model (1)	Model (2)	Model (3)	Model (4)
Intercept	2.02 (1.27)	2.20 (1.27)	4.76*** (1.27)	5.29*** (1.25)
Manipulation				
Type of Help	0.86* (0.42)	0.82* (0.41)	-1.64*** (0.43)	-1.41*** (0.41)
Mediation				
Loss of Competence-Based Self-Esteem	-	-	-	-0.26* (0.11)
Moderation				
AI Knowledge	-	-0.23 (0.23)		-
Type of Help x AI Knowledge	-	0.70* (0.29)	-	-
Controls	Yes	Yes	Yes	Yes
R²	0.14	0.20	0.21	0.27

Note: $N = 92$; values without parentheses are beta coefficients; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ρ = standard error; Controls = Age, Gender, Personal Innovativeness, Product Knowledge, Programming Frequencies, Negative Affectivity

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