How an Agile Software Process Increases Developers' Job Satisfaction: A Stress Perspective Based on the Effort-Reward-Imbalance Model

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Note: All references cited in this Supplementary Material are available in the main paper.

Appendix 1

Based on the major characteristics of related work and the current study (summarized in Table 1 and Table 2), this appendix describes the studies in more detail and specifically outlines why and how agile approaches affect HR factors. Tripp et al (2016) used the job characteristics model by Hackman and Oldham (1980) to identify five characteristics that influence workers' perceptions of the job and corresponding attitudes: 1. task significance ("the extent to which people believe that their job impacts the lives of people—either society at large or in an organization"); 2. task identity ("the extent to which a job's tasks are "whole" or involve the completion of an identifiable outcome"); 3. skill variety ("the extent to which one perceives a job as requiring a variety of skills, talents, and experiences"); 4. job autonomy ("the extent to which an employee has the discretion about how to complete the work required and set a schedule for completion"); 5. feedback ("the extent to which the process of completing the work provides employees with information through which they can evaluate their own performance"). Tripp and colleagues argue that agile development teams organize work in a way so that the team members perceive their job characteristics more positively. The reason for this positive effect is that agile job principles directly affect job characteristics. For example, customer relationships in agile development positively affect skill variety, job autonomy, and feedback. Moreover, Tripp et al. (2016) argue that agile practices can streamline software development processes by encouraging team members to merge their skills and duties while jointly taking on responsibilities, and this method enhances how job characteristics are perceived and improves related attitudes such as job satisfaction. Further, they argue that use of agile methods requires developers to assume responsibility for developing software, and not to take "an assembly line approach in which each worker performs a small part of the work and then hands it off to the next worker" (p. 271). Hence, using agile methods comes along with a better understanding of the scope and relevance of the work being performed.

In their study on developers' job satisfaction, Venkatesh et al. (2023) used Blau's (1964) social exchange theory "given its focus on social exchange between team leaders and team members as well as between team members" (p. 1242). Venkatesh and colleagues argue that information systems development team leaders establish high LMX (leader-member exchange) so that favored developers feel a duty to align with the leaders' objectives. By fostering high LMX, team leaders grant these privileged team members access to valuable resources that are less accessible to other employees. As a result, these team members feel compelled to reciprocate the benefits they receive and are likely to act in the leader's interest, strengthening their relationship. They further indicate that social exchange relationships between individual software engineers within a team "follow the same mechanisms of resource exchange, obligation, and reciprocation" (p. 1242). Thus, this study highlights the crucial role of agility in facilitating effective social exchange and resource management within information systems development teams, ultimately contributing to strengthened leader-member relationships and reciprocal dynamics among team members.

Tuomivaara et al. (2017) compared high and low perceived agile work in software development teams and measured mental workload based on heart rate and heart rate variability (HRV). Applying a physiological stress model (Collins et al. 2005) and related literature, they indicate that stress-related reduced heart rate variability (HRV) is due to a decrease in parasympathetic activity, primarily mediated by the vagus nerve, and/or an increase in sympathetic activity within the autonomic nervous system. The balance between sympathetic and parasympathetic indicators, reflected in HRV, can signal mental overload. A shift towards sympathetic dominance, characterized by an increased heart rate and lower

HRV, is termed stress time in the paper, while a shift towards parasympathetic dominance is referred to as relaxation time (p. 858). Importantly, this interpretation of physiological changes in software developers is supported by the stress literature (e.g., Riedl 2013) and by recent NeuroIS research (e.g., Stangl and Riedl 2022). Physiological measurements were taken three times, and based on the collected longitudinal data, evidence was found that "agile work could even out workload during a working period, i.e. maintain sustainable pace" (p. 857). It follows that the results suggest that developers who perceive high agile work have less mental workload because work does not accumulate at the end of a working period as much as it does in more traditional and plan-based development environments. In other words, developers who perceive high agile work feel less strain from the pressure of deadlines.

Karasek's (1979) job demand-control model conceptualizes two dimensions of the work environment that cause stress: 1. job demands (which determine an employee's workload), 2. job control (i.e., the employee's ability to direct or manage workflows and activities). A major prediction of the model is that high job demands in combination with low control lead to the highest work stress because "work is more challenging and [… employees] have limited authority to determine how to manage the execution of that work" (Windeler et al. 2017, p. 776). The opposite prediction is that low demands in combination with high control lead to the lowest work stress because "work is less challenging and [… employees] have the authority they need to manage their work" (Windeler et al. 2017, p. 776). Windeler et al. (2017) argue that in information systems development (ISD) teams the workload that results from job demands is predominantly determined by ISD project characteristics such as size, complexity, and target volatility (summarized as technical ISD risk factors). Furthermore, they instantiate agile development with respect to the job demand-control model and indicate that from the perspective of job demands-control theory, traditional project management methods could heighten stress by raising demands and limiting a developer's control, such as through more complicated reporting requirements. For ISD projects with significant technical risk factors, a leadership style that combines structure with flexibility can offer the essential support developers need to manage demands effectively and feel a sense of control, thereby reducing stress. Another argument by Windeler et al. (2017) is that actually stressful events such as changing requirements in software development do typically not induce much stress in agile environments because developers are "more effective in adapting their work to meet new demands" (p. 783), and this may positively affect team performance of agile development teams. However, the major result of their study is that project size, complexity, and target volatility may significantly increase developer stress in agile software teams, mediated by increasing role ambiguity and role conflict.

Venkatesh et al. (2020) also applied Karasek's (1979) job demand-control model and developed a theoretical framework linking agile method use to individual developer skills and to role conflict and role ambiguity. Venkatesh and colleagues argue that the use of Karasek's (1979) model helps understanding the influence of agility on developers' work exhaustion because this model conceptualizes the mismatch between employees' capabilities (including their capabilities to control their environment) and the demands of their work environment to determine work exhaustion. Specifically, role conflict and role ambiguity were used to explain why agile method use influences work exhaustion. Moreover, organizational skills of developers were found to change the influence of agile method use on work exhaustion. The more pronounced the organizational skills, the more agility reduced work exhaustion.

The holistic stress process model by Nelson and Simmons (2003) constitutes a representation of how occupational stress unfolds from an employee's perspective interacting with the workplace environment. This model conceptualizes both positive and negative psychological responses to demands. The stress process is triggered by environmental demands and consists of three evaluation processes: appraisal process, response process, and performance process. Benlian (2022), drawing upon this stress model,

indicates that an employee's behavior is shaped based on the interaction of the physical-technological environment, the social environment, and the "self-system" of the focal person, comprising perceptions, beliefs, attitudes, and habits. Importantly, this model conceptualizes environmental demand as neutral. What follows is that whether a demand is positive or negative depends on how an individual appraises the demand. Benlian (2022) gives the example of time pressure, which can be appraised "as a challenge stressor (by experiencing it as a motivating and stimulating force), such that it promotes goal achievement, or as a hindrance stressor (by constraining attentional resources, thus increasing the chance of misjudgment), such that it thwarts goal achievement" (p. 561).

According to Nelson and Simmons (2003), a positive psychological response may come along with states such as positive affect and engagement, while a negative psychological response may come along with negative affect, fatigue, and exhaustion. Once the psychological response has taken place, the performance process begins, during which—according to Benlian (2022)—the individual "decides how to act or perform in the workplace" (p. 561). The holistic stress process model, as well as its applications, typically conceptualize health, well-being, job satisfaction, and/or work performance as outcome variables. Benlian (2022) proposes that the daily engagement with work routines (e.g., daily standups and refactoring), social interactions (e.g., pair programming and client meetings), and artifacts (e.g., sprint backlog and lightweight documentation) involved in the use of agile information systems development practices (AISDPU) generate situational demands related to time, change, and transparency. These demands can lead to varying appraisal and stress response processes. This explains why the nature of the relationship between the use of agile approaches and HR factors is complex, and it may even explain why one developer in an agile environment may perceive stress on some days, but not on others. Moreover, Benlian (2022) found that a software developer's personality may affect outcome variables. Specifically, it was found that a developer's IT mindfulness (the person focuses "on the present, pays attention to detail, exhibits a willingness to consider other uses, and expresses genuine interest in investigating IT features and failures" (after Thatcher et al. 2018, pp. 832-834) facilitated challenge appraisals and acted as a buffer against threat appraisals, thereby increasing work engagement and reducing resource depletion. This positively affected well-being.

Ego depletion theory refers to the phenomenon that self-control is a limited mental resource (Baumeister et al. 1998). Lower energy levels result in lower levels of mental activity, which, in turn, leads to impaired self-control (i.e., a state of ego depletion). Self-control is not only critical for the functioning of the self on an individual level, but also affects social processes. Based on this foundation, Müller and Benlian (2022) applied ego depletion theory, focused on self-regulatory resources, and investigated how and why the use of agile information system development (ISD) practices may result in both benefits and costs for software developers. Specifically, Müller and Benlian (2022) examined whether developers might need to expend varying levels of their personal self-regulatory resources to manage the demands of agile ISD work structures. This perspective on self-regulation offers a balanced view of the psychological mechanisms that account for both the positive and energizing effects and the unintended negative and depleting outcomes associated with the use of agile ISD practices. They instantiated ego depletion theory to the context of agile software development practices. As an example, they argue that continuous feedback in agile work contributes to "smoothening processes, enhancing understanding, facilitating collaboration, and reducing the level of frictions lowering stress, cognitive demands, and negative feelings among developers" (p. 1425). What follows is that software developers in agile teams may feel less fatigue, because less self-regulatory resources are needed. In addition to this "feedback" characteristic of agile work, several other characteristics (e.g., application of coding standards, refactoring during software development) are discussed and it is shown that these characteristics may, but not necessarily, attenuate ego depletion, thereby positively affecting outcome

variables such as turnover intention. However, Müller and Benlian (2022) also found that perceived workload strengthened the energizing effects of AISDPU, coming along with a depleting effect.

Appendix 2

Appendix 2 lists construct definitions and the measurement scales which we used to measure the four constructs of our theoretical model. All items were measured on a seven-point Likert scale, with "Strongly disagree" to "Strongly agree", with * representing the exception; these items were measured using "Never" to "All the time". Agility is shown with all eight dimensions and corresponding items.

Table A2-1: Construct Definitions and Measurement Scales

Construct and Definition	**Measurement Scale and Source**	**Dimensions and Items**
Agility The frequency and intensity with which developers apply agile practices (based on Venkatesh et al. 2020, p. 738).	Maruping et al. (2009, p. 396); note that the last dimension "customer relation" is based on Tuomivaara et al. (2017, p. 861)	*Pair programming* How often is pair programming used on this team?* On this team, we do our software development using pairs of developers. To what extent is programming carried out by pairs of developers on this team?* *Continuous integration* Members of this team integrate newly coded units of software with existing code. We combine new code with existing code on a continual basis. Our team does not take time to combine various units of code as they are developed. (reverse item) (Note that this item was dropped.) *Refactoring* Where necessary, members of this team try to simplify existing code without changing its functionality. We periodically identify and eliminate redundancies in the software code. We periodically simplify existing code. *Unit testing* We run unit tests on newly coded modules until they run flawlessly. Members of this team actively engage in unit testing. To what extent are unit tests run by this team?* *Collective ownership* Anyone on this team can change existing code at any time. If anyone wants to change a piece of code, they need the permission of the individual(s) that coded it. (reverse item) (Note that this item was dropped.) Members of this team feel comfortable changing any part of the existing code at any time. *Coding standards* We have a set of agreed upon coding standards in this team. Members of this team have a shared understanding of how code is to be written. Everyone on this team uses their own standards for coding. (reverse item) *Requirements change* Requirements fluctuated quite a bit in early phases of this project. Requirements fluctuated quite a bit in later phases of this project. Requirements identified at the beginning of the project were quite different from those toward the end. *Customer relation* I discuss the needs related to the project with the customer representative. Developers take part in defining the requirements with the customers. The team extensively and systematically receives information on the needs and wishes of the customer. (Note that this item was dropped.)

Job satisfaction A positive emotional state resulting from the appraisal of one's job or job experiences" (based on Locke 1976, p. 1300).	Ragu-Nathan et al. (2008, p. 426)	I like doing the things I do at work. I feel a sense of pride in doing my job. My job is enjoyable.
Stress A state of mental tension caused by a difficult situation (based on WHO 2023); in the present context the result of an imbalance between effort and reward (Siegrist et al. 2009). **Reward** A stimulus that causes positive feelings (based on Schultz 2006) **Effort** The energy needed to do something (based on Cambridge University Press 2024)	**Stress (Effort-Reward Imbalance)** Siegrist et al. (2009, pp. 1011-1012)	I have constant time pressure due to a heavy workload. (effort) I have many interruptions and disturbances while performing my job. (effort) Over the past few years, my job has become more and more demanding. (effort) I receive the respect I deserve from my superior or a respective relevant person. (reward – esteem dimension) My job promotion prospects are poor. (reverse item) (reward – job promotion dimension) I have experienced or I expect to experience an undesirable change in my work situation. (reverse item) (reward – job security dimension) My job security is poor. (reverse item) (reward – job security dimension) Considering all my efforts and achievements, I receive the respect and prestige I deserve at work. (reward – esteem dimension) Considering all my efforts and achievements, my job promotion prospects are adequate. (reward – job promotion dimension) Considering all my efforts and achievements, my salary/income is adequate. (reward – job promotion dimension)
Overcommitment Attitudes, behaviors, and emotions that reflect excessive endeavor in combination with a strong desire for approval and esteem (based on Tsutsumi and Kawakami 2004, p. 2336).	Siegrist et al. (2009, p. 1012)	I get easily overwhelmed by time pressures at work. As soon as I get up in the morning, I start thinking about work problems. When I get home, I can easily relax and 'switch of' work. (reverse item) People close to me say I sacrifice too much for my job. Work rarely lets me go, it is still on my mind when I go to bed. If I postpone something that I was supposed to do today, I'll have trouble sleeping at night.

Appendix 3

In this appendix we report the reliability, convergent validity, and discriminant validity of the construct measures. We also report their means and standard deviations (SD). Reliability is represented by Cronbach's alpha; satisfactory values exceed 0.70 (Nunnally 1978). All alphas exceeded this threshold except for Customer Relation (a dimension of Agility), where we observed a minor deviation (see Table A2-1). Its alpha is 0.68 with a confidence interval of 0.56 - 0.76. The convergent validity of a construct is considered satisfactory if its AVE (Average Variances Extracted) is at least 0.50; the discriminant validity of a construct is considered adequate if the square root of the AVE is greater than the interconstruct correlations (Fornell and Larcker 1981). All AVE values meet the 0.50 threshold (see Table A3-1) with one exception (overcommitment: 0.44), and the square root of each construct's AVE was greater than the correlations between that construct and all others (see Table A3-2). Regarding the small deviation of overcommitment of 0.06 (0.50-0.44), however, we do not see a measurement problem as described by Siegrist et al. (2014, p. 5), who argue that such deviations have sometimes been observed in empirical studies based on the ERI framework. Thus, these results indicate good reliability and construct validity (i.e., convergent and discriminant validity).

Table A3-1: Reliability and Convergent Validity

	Number of Items	AVE	Alpha	Mean	SD
Agility					
Pair programming (PP)	3	0.75	0.90	7.69	3.84
Continuous Integration (CI)	2	0.76	0.86	17.42	4.33
Refactoring (RE)	3	0.75	0.89	13.81	4.66
Unit Testing (UT)	3	0.84	0.94	13.73	5.88
Collective Ownership (CO)	2	0.58	0.73	14.99	4.67
Coding Standards (CS)	3	0.60	0.81	17.70	3.24
Requirements Change (RC)	3	0.55	0.76	12.17	3.84
Customer Relation (CR)	2	0.52	0.68	12.31	5.42
Job Satisfaction	3	0.61	0.80	17.37	2.98
Effort	3	0.56	0.79	13.44	4.11
Reward	7	0.50	0.83	34.67	8.18
Overcommitment	6	0.44	0.81	19.04	7.55

Table A3-2: Discriminant Validity

Inter-construct Correlations*								
Agility	PP	CI	RE	UT	CO	CS	RC	CR
PP	**0.866**							
CI	0.082	**0.873**						
RE	0.166	0.234	**0.864**					
UT	0.12	0.253	0.326	**0.914**				
CO	0.12	0.175	0.238	0.16	**0.762**			
CS	0.081	0.228	0.382	0.407	0.237	**0.772**		
RC	0	-0.135	-0.103	-0.161	-0.051	-0.186	**0.742**	
CR	0.185	0.165	0.128	0.055	0.154	0.118	0.124	**0.718**

	Job Satisfaction	Effort	Reward	Overcommitment
Job Satisfaction	**0.866**			
Effort	-0.213	**0.873**		
Reward	0.473	-0.308	**0.864**	
Overcommitment	-0.25	0.502	-0.242	**0.914**

Notes: pair programming (PP), continuous integration (CI), refactoring (RE), unit testing (UT), collective ownership (CO), coding standards (CS), requirements change (RC), and customer relation (CR). * Diagonal elements in bold are square roots of the Average Variance Extracted.

Appendix 4

We controlled for gender, age, work experience, and education. Table A4-1 summarizes the statistics including these control variables. Essentially, the hypotheses testing results reported in the main paper remain stable and significant when the control variables are included.

Table A4-1: Statistics with Control Variables (Gender, Age, Work Experience, Education) based on Model 4 according to Hayes (2018a)

Direct Effect of Agility on Job Satisfaction					
Effect	SE	t	p	LLCI	ULCI
0.0141	0.0118	1.1945	0.2339	-0.009	0.0373
Indirect Effect of Agility on Job Satisfaction with Stress (Effort-Reward Imbalance) as Mediator					
Effect	Boot SE	—	—	Boot LLCI	Boot ULCI
0.0101	0.0055	—	—	0.001	0.0228

Notes: SE = Standard Error, LLCI = Lower Limit Confidence Interval, ULCI = Upper Limit Confidence Interval. Boot = Bootstrapping (note that with bootstrapping there is no t-value and p-value because it is a non-parametric method that makes no assumptions about the distribution of the underlying data).

Table A4-2: Statistics with Control Variables (Gender, Age, Work Experience, Education) based on Model 7 according to Hayes (2018a)

Direct Effect of Agility on Job Satisfaction						
	Effect	SE	t	p	LLCI	ULCI
	0.0141	0.0118	1.1945	0.2339	-0.009	0.0373
Conditional Indirect Effects of Agility on Job Satisfaction with Stress (Effort-Reward Imbalance) as Mediator at Values of the Moderator						
Level[a]		Effect	Boot SE	Boot LLCI	Boot ULCI	Zero Included?[b]
Low	11.4941	0.0202	0.0069	0.0092	0.0364	No
Mean	19.0393	0.0084	0.0045	0.0006	0.0187	No
High	26.5846	-0.0034	0.0071	-0.0184	0.0099	Yes
Index of Moderated Mediation		Index	Boot SE	LLCI	ULCI	
		-0.0016	0.0007	-0.0032	-0.0004	No

Notes: SE = Standard Error, LLCI = Lower Limit Confidence Interval, ULCI = Upper Limit Confidence Interval. Boot = Bootstrapping.

[a] Low = The conditional indirect effect at low levels of the moderator (one standard deviation below the mean). Mean = The conditional indirect effect at an average level of the moderator (at the mean). High = The conditional indirect effect at high levels of the moderator (one standard deviation above the mean).

[b] "No" means that zero is not included in the confidence interval and that the indirect effect is significant.

Appendix 5

We tested our data for heteroskedasticity. The statistics are reported in Tables A5-1 and A5-2. In some cases, it was found that heteroskedasticity could not be ruled out. In order to account for the effects of heteroskedasticity in the calculations, it is necessary to work with robust standard errors. The calculations with robust standard errors (based on the HC3 method, Heteroskedasticity-consistent standard errors) have been included in the calculations in the main paper.

Table A5-1: Heteroskedasticity Tests (based on Model 4 according to Hayes 2018a)

Modell M (M ~ X)		
	Breusch-Pagan-Test	White-Test
LM Statistic	0.0695	0.2022
LM Test p-value	0.792	0.9039
F-Statistic	0.0688	0.0995
F-Test p-value	0.7934	0.9053
Modell Y (Y ~ X + M)		
	Breusch-Pagan-Test	White-Test
LM Statistic	6.2548	12.4214
LM Test p-value	0.0438	0.0294
F-Statistic	3.1867	2.5806
F-Test p-value	0.0437	0.028

Table A5-2: Heteroskedasticity Tests (based on Model 7 according to Hayes 2018a)

Modell M (M ~ X * W)		
	Breusch-Pagan-Test	White-Test
LM Statistic	2.808616539	6.73235743
LM Test p-value	0.422083445	0.56576533
F-Statistic	0.929838877	0.83040234
F-Test p-value	0.427579616	0.57694855
Modell Y (Y ~ X + M + W + I(X * W))		
	Breusch-Pagan-Test	White-Test
LM Statistic	9.81308776	22.2756484
LM Test p-value	0.043696686	0.05123523
F-Statistic	2.523478432	1.80457243
F-Test p-value	0.042734075	0.04610123

Appendix 6

We used eight agile practices (i.e., dimensions) to measure agility (Maruping et al., 2009; Venkatesh et al. 2020): pair programming (PP), continuous integration (CI), refactoring (RE), unit testing (UT), collective ownership (CO), coding standards (CS), requirements change (RC), and customer relation (CR). Therefore, we conducted further analyses based on Model 7 according to Hayes (2018a) in order to investigate the results of the moderated mediation model along these eight dimensions. The results are shown in Table A6-1.

Table A6-1: Results of the Moderated Mediation Model Testing along the Eight Agility Dimensions (based on Model 7 according to Hayes 2018a)

PP					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	-0.0137	0.798	0.0535	-0.1186	0.0912
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.006	0.0028	-0.0119	-0.0011	No
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0839	0.0342	0.027	0.1598	No
medium	0.039	0.0219	0.0047	0.0903	No
high	-0.0059	0.0255	-0.0547	0.0476	Yes
CI					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	-0.0165	0.7261	0.0469	-0.1085	0.0755
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0043	0.003	-0.0112	0.0009	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0693	0.0315	0.0174	0.1427	No
medium	0.0369	0.0192	0.0055	0.0814	No
high	0.0045	0.0275	-0.0487	0.0601	Yes
RE					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.0561	0.2722	0.0509	-0.0437	0.1559
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0031	0.0028	-0.0096	0.0015	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0645	0.0285	0.0195	0.1335	No
medium	0.0408	0.0183	0.0106	0.0838	No
high	0.0171	0.0269	-0.038	0.0704	Yes
UT					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.0013	0.9745	0.0399	-0.0769	0.0794
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0026	0.002	-0.0074	0.0006	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0419	0.0217	0.0066	0.0944	No
medium	0.0219	0.0132	-0.0015	0.0512	Yes
high	0.002	0.0179	-0.0371	0.0344	Yes
CO					

direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.0371	0.4995	0.0548	-0.0703	0.1445
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0028	0.0022	-0.0082	0.001	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0671	0.0256	0.0257	0.1319	No
medium	0.0463	0.0164	0.0189	0.0837	No
high	0.0255	0.0214	-0.0161	0.0689	Yes
CS					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.0668	0.3298	0.0683	-0.0671	0.2007
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0052	0.0043	-0.0156	0.0017	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0747	0.044	0.006	0.1842	No
medium	0.0353	0.0266	-0.0107	0.094	Yes
high	-0.0042	0.04	-0.092	0.0686	Yes
RC					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	-0.0235	0.7191	0.0653	-0.1515	0.1044
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0003	0.0032	-0.0065	0.0062	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	-0.0742	0.0358	-0.1641	-0.0199	No
medium	-0.0767	0.0255	-0.1353	-0.0353	No
high	-0.0791	0.0348	-0.1615	-0.0235	No
CR					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.084	0.0223	0.0364	0.0126	0.1554
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.002	0.0021	-0.0063	0.0023	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0147	0.021	-0.0264	0.0583	Yes
medium	-0.0001	0.0157	-0.0297	0.0327	Yes
high	-0.0149	0.0239	-0.0594	0.0361	Yes

Notes: SE = Standard Error, LLCI = Lower Limit Confidence Interval, ULCI = Upper Limit Confidence Interval; pair programming (PP), continuous integration (CI), refactoring (RE), unit testing (UT), collective ownership (CO), coding standards (CS), requirements change (RC), and customer relation (CR). "No" in the column "Zero Included?" means that zero is not included in the confidence interval and that the indirect effect is significant. *: $p < 0.05$.

Appendix 7

We analyzed how agility influences the effort component on the one hand and the reward component on the other and how both effort and reward affect job satisfaction based on Model 7 according to Hayes (2018a). The statistics are shown in Table A7-1. In essence, when effort is used as a mediator, there is both a direct and an indirect effect of agility on job satisfaction. However, when reward is used as a mediator, there is no direct effect, but an indirect effect of agility on job satisfaction that decreases with increasing overcommitment.

Table A7-1: Influence of Agility on Effort and Reward (based on Model 7 according to Hayes 2018a)

Effort					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.0234	0.0423	0.0114	0.001	0.0457
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0008	0.0004	-0.002	-0.0002	No
levels					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0069	0.0042	0.0006	0.0178	No
medium	0.0006	0.0025	-0.0044	0.0059	Yes
high	-0.0057	0.004	-0.0161	0.0001	Yes
Reward					
direct_effect					
type	effect	p	SE	LLCI	ULCI
direct_effect	0.003	0.7975	0.0118	-0.0201	0.0262
combined indirect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
index_of_moderated_mediation	-0.0012	0.0008	-0.0032	0.0002	Yes
levels of indirect effect					
type	indirect_effect	SE	LLCI	ULCI	Zero Included?
low	0.0301	0.0083	0.0169	0.05	No
medium	0.0207	0.0061	0.0105	0.0345	No
high	0.0112	0.0093	-0.0056	0.0312	Yes

Notes: SE = Standard Error, LLCI = Lower Limit Confidence Interval, ULCI = Upper Limit Confidence Interval. "No" in the column "Zero Included?" means that zero is not included in the confidence interval and that the indirect effect is significant. *: $p < 0.05$.

Appendix 8

Control variables studied in the related work are (listed in verbatim and in the order in which they are indicated in the papers): Tripp et al. (2016, p. 283): negative affectivity, age, organizational tenure, gender, education, total work experience; Tuomivaara et al. (2017): gender, age; Windeler (2017, p. 14): developer location, developer experience, team size, team distribution, leader experience, managerial project control, pre-project job stress; Venkatesh et al. (2020, p. 744): age, gender, team tenure, experience in software development (in general and in using XP in particular), perceived autonomy, perceived fairness of rewards, perceived workload, team size, requirements uncertainty, presence of a client representative in the project team; Benlian (2022, Appendix B): age, gender, agile development experience, total work experience, team size, project size, project complexity, (job-related) developer stress, global life satisfaction, baseline scores of resource depletion and work engagement, developers' late afternoon positive and negative affect, day of the study; Müller and Benlian (2022, p. 10): gender, age, organizational tenure, negative affect, team size, team dispersion; Venkatesh et al. (2023, p. 1244): gender, development experience, LMX (leader-member exchange), team size, project complexity, requirements volatility, agile ISD (information systems development) training. Note that the factors were considered distinct if their names were not exactly the same. After merging similar ones such as "negative affectivity" (Tripp et al., 2016) and "negative affect" (Benlian, 2022), we still have a total of 27 unique control variables.