Organizational and perceived learning in the workplace:

a multilevel perspective on employees' problem solving

APPENDIX A: Details on sample design

We adopted a mixed method sampling technique by combining cluster sampling and purposive sampling (Teddlie and Yu, 2007). Specifically, we first clustered the population of manufacturing firms by selecting medium to large sized manufacturing firms (more than 50 employees) located in the Northeast of Italy, a highly industrialized region with a population of firms that account for more than 30% of the Italian manufacturing system. We contacted some 80 firms according to the drop-and-collect survey method, which is appropriate when the population is geographically clustered and social contact with key informants is necessary for effective communication (Ibeh et al., 2004). As gaining direct contact with shop-floor employees requires approval at several hierarchical levels of the organization, it was important to meet the top management in order to ensure that the study was feasible, its objectives were clearly understood, and shop-floor employees were appropriately selected. These firms were contacted by phone and asked whether they were interested in participating in the research. Sixty-one firms indicated an interest in being involved in the study. We visited the plants, presented the research design, and gave detailed information about the duration, methods of administration, and respondents' profile. As a token for the participation, we offered firms to provide a detailed summary of the research findings with a benchmark analysis. In nine cases, the top management decided not to participate in this study because of time constraints or busy due to internal reorganizations. A second stage of clustering for each of the remaining 52 firms involved the selection of one manufacturing unit within the main plant of the firm. A manufacturing unit represents an organizational entity that performs an operational process or produces a family of products. Examples of manufacturing units are a manufacturing cell, a manufacturing workshop, an assembly line. To select the manufacturing unit, in line with purposive sampling, we asked firms' managers to identify the most critical manufacturing units (i.e., a workshop performing the most important value-added process, an assembly line in charge of a complex product). The resulting manufacturing units

have a minimum of 5 and a maximum of 13 employees. The top management informed the employees in the manufacturing unit about the survey and explained them participation was optional and no one was forced to take part. This purposive sampling selects cases ‘‘based on a specific purpose rather than randomly’’ (Tashakkori and Teddlie, 2003:713), thus enabling the comparability across manufacturing units in different plants to study the influence of knowledge-related mechanisms on shop-floor employees. In the identified manufacturing units, we had a 100% response because all the employees in the manufacturing units agreed to participate in the survey, thus collecting a total of 401 questionnaires. We dropped 18 observations because of missing data in the main variables of interest (Hair et al., 2006).

Our final sample was composed of 383 shop-floor workers from 52 manufacturing units of 52 different plants[1]. Descriptive statistics about the plants and industry sectors are available from the authors upon request. The average number of shop-floor employees per manufacturing unit was 7.4; most of them were men (76%). With regard to the age, 21% were between 18 to 30 years, 45% between 31 to 45 years, 33% between 46 to 60 years, and 1% above 60 years. With regard to education, only 6 workers (1.6%) reported elementary school degree, 46% had a junior high school degree and 53% had at least a high-school degree.

APPENDIX B: Translation of the questionnaire using Brislin (1980) method

The preliminary English version of the questionnaire was translated to Italian by a professional translator fluent in both languages (English-native speaker). A small group of three researchers proficient in both languages reviewed the Italian translation separately and agreed that the quality of the translation was appropriate (the SPS scale was translated even if Soresi and Mirandola (1998) had already translated it and validated in numerous studies; by comparing the translation provided by the professional translator

[1] Our sample size at the highest level (i.e., manufacturing units) is based on Maas and Hox’s (2004) rule: “if one is only interested in the fixed effects of the model, ten groups can lead to good estimates. If one is also interested in contextual effects, 30 groups are needed. If one also wants correct estimates of the standard errors, at least 50 groups are needed” (p.135).

with the one provided by Soresi and Mirandola, we were able to further validate the quality of the translation). The questionnaire was then back-translated into English by another professional translator fluent in both languages (English-native speaker) unfamiliar with the original English version. Finally, the small group of researchers reviewed the back-translation separately and agreed that the actual meaning of the concepts of the items in the original and target version of the questionnaire remained equivalent.

APPENDIX C: Problem solving scales developed by Maydeu-Olivares and D'Zurilla (1997)

Table C: Items, means, SD and EFA loadings of PSS and PSSE

Code	Measurement items	Mean	SD	Factor 1	Factor2
PSS	**Problem solving skills**				
SPS01	When considering solutions to a problem, I do not take the time to assess the potential success of each alternative.*	5.05	1.48	.78	-.10
SPS02	When confronted with a problem, I usually first survey the situation to determine the relevant information.	5.42	1.22	.78	.07
SPS03	When I have a problem, I think of as many possible ways to handle it as I can until I can't come up with any more ideas.	5.05	1.31	.61	.15
SPS04	After following a course of action to solve a problem, I compare the actual outcome with the one I had anticipated.	5.14	1.20	.67	.00
SPS05	When making a decision, I compare alternatives and weigh the consequences of one against the other.	5.19	1.23	.67	.14
SPS06	When confronted with a problem, I stop and think about it before deciding on a next step.	5.42	1.17	.81	.00
SPS07	When thinking of ways to handle a problem, I seldom combine ideas from various alternatives to arrive at a workable solution.*	5.11	1.39	.76	-.06
SPS08	I try to predict the result of a particular course of action.	5.00	1.20	.16	.18
SPS09	When a solution to a problem has failed, I do not examine why it didn't work.*	5.60	1.42	.81	-.03
PSSE	**Problem solving self-efficacy**				
PSSE01	Given enough time and effort, I believe I can solve most problems that confront me.	5.38	1.19	.05	.71
PSSE02	I have the ability to solve most problems even though initially no solution is immediately apparent.	4.98	1.14	-.14	.89
PSSE03	When I make plans to solve a problem, I am almost certain that I can make them work.	5.04	1.13	.05	.73
PSSE04	I trust my ability to solve new and difficult problems.	5.29	1.15	.06	.80
PSSE05	Many of the problems I face are too complex for me to solve.*	5.22	1.29	.15	.63
PSSE06	When my first efforts to solve a problem fail, I become uneasy about my ability to handle the situation.*	5.05	1.51	.12	.55
PSSE07	When faced with a novel situation, I have confidence that I can handle problems that may arise.	4.86	1.16	-.03	.77

* Items to be reversed.

APPENDIX D: Items from the questionnaire and factor analyses

Table D reports factor names, measurement items, means, standard deviations (SD), factor loadings from exploratory factor analysis, Composite Reliability (CR) and Cronbach's Alpha for all constructs in the questionnaire[2].

Table D. Items, means, SD, EFA loadings, Composite Reliability and Cronbach's Alpha

Code	Measurement items	Mean	SD	Load	CR	Alpha
SPS	**Systematic problem solving scale**				**.90**	**.87**
SPS01	When considering solutions to a problem, I do not take the time to assess the potential success of each alternative.*	5.05	1.48	.71		
SPS02	When confronted with a problem, I usually first survey the situation to determine the relevant information.	5.42	1.22	.82		
SPS03	When I have a problem, I think of as many possible ways to handle it as I can until I can't come up with any more ideas.	5.05	1.31	.71		
SPS04	After following a course of action to solve a problem, I compare the actual outcome with the one I had anticipated.	5.14	1.20	.68		
SPS05	When making a decision, I compare alternatives and weigh the consequences of one against the other.	5.19	1.23	.77		
SPS06	When confronted with a problem, I stop and think about it before deciding on a next step.	5.42	1.17	.81		
SPS07	When thinking of ways to handle a problem, I seldom combine ideas from various alternatives to arrive at a workable solution.*	5.11	1.39	.72		
SPS08	*I try to predict the result of a particular course of action.***	*5.00*	*1.20*	*.28*		
SPS09	When a solution to a problem has failed, I do not examine why it didn't work.*	5.60	1.42	.78		
KC	**Knowledge codification scale**				**.90**	**.86**
KC01	The members of our organization use often manuals*** to perform daily tasks.	4.26	1.69	.79		
KC02	Our organization invests resources in producing manuals that facilitate the performance of daily tasks.	4.17	1.64	.84		
KC03	In our organization, the employees have produced manuals in which they establish the main terms used in performing our work.	4.05	1.75	.75		
KC04	The members of our organization have easy access to manuals.	4.57	1.64	.79		
KC05	The organization's management motivates the development of manuals that can help the organization's employees.	4.31	1.58	.82		
KC06	The members of our organization have produced manuals that help employees to perform daily tasks.	4.71	1.63	.79		
KC07	*A person outside the organization could understand these manuals without having to be an expert in the subject matter.***	*3.62*	*1.79*	*.35*		

[2] Three constructs were present in the questionnaire but not included in the main results in the paper. These are: PSSE dimension of the PSI scale of Maydeu-Olivares and D'Zurilla (1997), see footnote 2 in the paper and Appendix C; job routineness (Boh and Wong, 2005) and time availability (Siemsen et al. 2008) that could have been used as control variables in our model because it is likely that employees with highly-routinized tasks and few available time at work engage less in SPS behavior. However, as the main results of interest did not change by adding these control variables, for the sake of simplicity in the paper we report a parsimonious model.

KA	**Knowledge articulation scale**				**.90**	**.86**
KA01	The members of the organization usually meet often to resolve work issues.	4.50	1.54	.82		
KA02	Any problem that emerges in any area of work is shared and discussed among the members working in this area.	4.92	1.49	.65		
KA03	In general, there is good communication among the members of the organization.	4.38	1.48	.80		
KA04	In our organization, the employees propose new ways of doing things, which are well accepted by the other employees.	4.41	1.55	.72		
KA05	The most frequent problems that emerge in performing our daily work are usually discussed as a group by the members of the organization.	4.32	1.54	.85		
KA06	The management of our organization promotes meetings to debate work problems, even though these meetings are held during the work day.	4.25	1.74	.79		
JC	**Job complexity scale**				**.90**	**.84**
JC01	The job comprises relatively uncomplicated tasks.*	4.04	1.48	.83		
JC02	The job requires that I only do one task or activity at a time.*	4.55	1.71	.75		
JC03	The tasks on the job are simple and uncomplicated.*	4.48	1.43	.90		
JC04	The job involves performing relatively simple tasks.*	4.25	1.48	.83		
JA	**Job automaticity scale**				**.87**	**.82**
	My job is something…					
JA01	I start doing before I realize I'm doing it.	2.74	1.78	.77		
JA02	I do without having to consciously remember.	3.11	1.81	.84		
JA03	I have no need to think about doing.	3.06	1.89	.77		
JA04	I do automatically.	3.79	1.82	.76		
JA05	I do without thinking.	2.42	1.73	.76		
JA06	*that would require effort not to do it.***	*2.92*	*1.65*	*.44*		
TC	**Task change scale**				**.85**	**.76**
TC01	I frequently change some of the activities that are part of my daily tasks.	4.26	1.72	.80		
TC02	I frequently change the way I perform body movements in my job.	3.97	1.72	.82		
TC03	I frequently change the sequence of standardized activities that I perform in my job.	3.94	1.71	.78		
TC04	I perform the sequence of standardized activities in my job always in the same way, without introducing any change.*	4.24	1.61	.66		

Note 1: * Reversed items

Note 2: **Items in *italic* (SPS08, KC07 and JA06) are not used in the main analyses in the paper due to low loadings in EFA.

Note 3: *** As firms can use other tools than manuals to codify knowledge, a note in the questionnaire helped respondents to understand what manuals refer to: "The following sentences contain references to manuals developed in your organization. In your organization, it is possible that these manuals are actually named using different words, for example, assembly instructions (printed material or photos), work instructions, standard procedures, documents, dictionaries or glossaries".

APPENDIX E: Robustness checks with additional covariates

Additional variables were included in our model of interest to further validate our results. In particular, at the individual level, we controlled for the characteristics of the respondents. These characteristics include dummy controls for gender (Male), age (a dummy if employees are Under 30 and a dummy if employees are Over 45, employees between 31 to 45 being the baseline age). Referring to education, as only 6 workers (1.5%) reported elementary school degree, we collapsed this degree together with the junior high school degree (the differences were never significant in preliminary analyses), leaving us with the dummy variable "High Education" that takes 1 if respondents have high school or higher education (about 53% of the respondents) and 0 otherwise. We also controlled for personality traits using the reduced version of the Big Five Personality Questionnaire (Gosling et al., 2003). Examples of these traits include extraversion, trustworthiness and openness. As Barrick et al. (2013) argued, personality traits have a potential important role in explaining behavior at work, including problem solving. For example, Naveh et al. (2015) show that personal characteristics may affect individual error rates, which might reflect the lack of SPS behavior. This suggests that personal characteristics may be an important explanation of the individual propensity to SPS. Finally, at the organizational level we use the logarithm of the number of employees to control for Firm size.

Table E shows the estimates of models involving socio-demographic individual characteristics (Model E1) and all control variables (E2). No significant changes for the parameters of interest emerge with respect to Model 1 from Table 2 in the main paper, thus we confirm our results are robust under different specifications of observable heterogeneity. Only few added control variables have significant effects. As regards individual characteristics, a lower SPS behavior is associated with disorganized employees and a higher SPS with highly educated, critical and dependable ones. Finally, at the organizational level, firm size has a significant positive effect both on OKC and SPS. Similar results are confirmed when estimating models with latent variables of interest and observed covariates.

Table E: MSEM with observed variables, additional covariates

	Model E1			*Model E2*		
	Demographics characteristics			All variables		
	Est.	s.e.	*p*	Est.	s.e.	*p*
Organizational level						
SPS						
OKC	.22	.06	.000	.17	.06	.002
OKA	.04	.06	.474	.05	.06	.311
Firm size				.10	.04	.022
OKC						
OKA	.63	.03	.000	.63	.03	.000
Firm size				.12	.04	.002
Individual level						
SPS						
PKC	.23	.05	.000	.24	.05	.000
PKA	.16	.05	.001	.14	.05	.003
Job complexity	.10	.05	.034	.09	.05	.068
Job automaticity	-.17	.05	.000	-.13	.05	.004
Task change	.06	.05	.205	.08	.05	.086
Male	-.03	.05	.511	.01	.05	.810
Under 30	.07	.05	.204	.06	.05	.221
Over 45	-.06	.05	.290	-.07	.05	.178
High education	.08	.05	.082	.08	.05	.066
Tenure	.09	.06	.108	.08	.05	.151
Extraverted				.01	.05	.844
Critical				.09	.05	.046
Dependable				.13	.05	.008
Anxious				-.06	.05	.210
Open to new experiences				.05	.05	.277
Reserved				.06	.05	.169
Sympathetic				.04	.05	.409
Disorganized				-.19	.05	.000
Calm				.06	.05	.203
Sample size	382			362		

APPENDIX F: Robustness checks using alternative measures of SPS, OKA and OKC

We develop alternative measures of SPS, OKA and OKC and run a series of supplemental tests to mitigate social desirability and common method biases.

On the one hand, as individuals might tend to overreport behaviors that comply to some social norms such as SPS, we use an alternative scale of SPS based on the vignette method (Parker et al. 2006; Choo et al., 2015). Following Parker et al. (2006), we described a scenario about a common problem that employees face. We identified this problem on the basis of discussions we had with supervisors of different plants. The scenario was linked to a series of six sentences. Each sentence describes a possible problem-solving behavior that employees have to rate on a 7-point Likert scale based on the extent to which the specific

behavior represents what they normally perform at work. We asked five external raters to read the definition of SPS and code the extent to which each of the six sentences describes a SPS behavior based on a scale ranging from 1 (not at all) to 5 (very much). They also rated the extent to which they were confident with the accuracy of their responses on a 5-point scale. Three sentences were rated as examples of SPS behavior and exploratory factor analysis confirms that these sentences load on one factor (the other three sentences are examples of workarounds and load on a different factor). Moreover, the vignette-based SPS is positively and significantly related to the original scale of SPS (ρ=0.50), thus confirming the robustness of our measure. The use of this technique serves as a robustness check for further validating our findings in order to alleviate the issue of the self-reported measure of SPS.

On the other hand, to investigate organizational knowledge using a different source, we asked supervisors to gauge the level of OKA and OKC in their manufacturing units. These plant-level measures are positively and significantly correlated to the corresponding original scales of OKA and OKC based on the unit-level aggregated responses of employees (ρ=.61 and ρ=.57, respectively).

We reestimate our main model using these alternative scales, and results remain substantially unchanged as shown in Table F.

Table F: MSEM with observed variables, different measures for SPS, OKA and OKC

	Model F1			*Model F2*			*Model F3*		
	Original SPS, OKA and OKC			OKC and OKA from supervisors			SPS new scale from vignettes		
	Est.	s.e.	*p*	Est.	s.e.	*p*	Est.	s.e.	*p*
Organizational level SPS									
OKC	.23	.06	.000	.26	.06	.000	.21	.06	.000
OKA	.04	.06	.464	-.02	.06	.772	.07	.06	.246
OKC									
OKA	.63	.03	.000	.64	.03	.000	.62	.03	.000
Individual level SPS									
PKC	.23	.05	.000	.24	.05	.000	.33	.05	.000
PKA	.16	.05	.001	.16	.05	.001	.18	.05	.000
Job complexity	.09	.05	.058	.11	.05	.016	.11	.05	.010
Job automaticity	-.16	.05	.001	-.16	.05	.000	-.08	.04	.068
Task change	.05	.05	.241	.03	.05	.498	.03	.04	.435
Sample size	383			383			383		

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