

# Perceived systems intelligence and performance in organizations

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## Abstract

**Purpose** – This study aims to introduce the perceived systems intelligence (SI) inventory, developed based on the earlier published self-report SI inventory (Törmänen *et al.*, 2016). It can be used together with earlier managerial level tools for building a learning organization and included in general 360-style evaluations in personnel development.

**Design/methodology/approach** – The inventory is validated with confirmatory factor analysis with a model based on the self-report SI inventory, using data from full-time used employees and managers in the USA and UK. Perceived SI factor scores are correlated with the perceived study performance of the individual.

**Findings** – The perceived SI inventory is found to have good factorial validity, and it correlates strongly with evaluations of perceived study performance. Managers perceived high in performance are also found to score high in perceived SI. Perceived SI does not depend on gender, age, organization size or industry.

**Originality/value** – The perceived SI inventory is the first personnel level peer evaluation tool suggested for developing learning organizations. The new inventory makes peer evaluations possible and provides a new grassroots level tool for personnel development programs in learning organizations.

**Keywords** Learning organizations, Systems intelligence, Peer evaluation

**Paper type** Research paper

## Introduction

Systems intelligence (SI) is a concept describing our abilities to succeed in complex situations in organizational settings and in our everyday life. Saarinen and Hämmäläinen (2004, p. 4) originally defined SI as:

[...] intelligent behavior in the context of complex systems involving interaction and feedback. A subject acting with Systems Intelligence engages successfully and productively with the holistic



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feedback mechanisms of her environment. She perceives herself as a part of a whole, the influence of the whole upon herself as well as her own influence upon the whole. By observing her own interdependence in the feedback intensive environment, she is able to act intelligently.

SI has been suggested as an essential competence needed in positions of leadership (Hämäläinen and Saarinen, 2006, 2007a) and has been applied for various fields such as organizational development (Luoma *et al.*, 2008, 2011), knowledge management (Sasaki, 2017), personal growth (Hämäläinen *et al.*, 2014; Saarinen and Lehti, 2014), therapy discourse (Martela and Saarinen, 2013), design thinking (Harviainen *et al.*, 2021; Jumisko-Pyykkö *et al.*, 2021) and engineering disciplines (Hämäläinen *et al.*, 2018). For a history of the SI perspective, see Törmänen (2021).

SI draws from Peter Senge's seminal management book *The Fifth Discipline* (Senge, 1990), which introduced what Senge calls the five disciplines of the learning organization – systems thinking, personal mastery, mental models, building shared vision and team learning. SI seeks to operationalize Senge's vision of the learning organization and integrate it conceptually. To this effect, the original SI inventory of 2016 offered a self-evaluation questionnaire (Törmänen *et al.*, 2016). The more recent organizational SI inventory focused on SI in organizations (Törmänen *et al.*, 2021). The current paper takes the SI perspective yet one more step further, extending it to the peer level.

While Senge's work has been hailed as “almost synonymous with the idea of learning organization” (Örtenblad, 2018), quantitative models of the learning organization have often bypassed key aspects of Senge's vision, especially regarding insights that are difficult to operationalize or control with managerial structures. In her recent overview, Bui highlighted Senge's constructs of personal mastery and systems thinking as ideas that “have powerfully shaped new ways to see the world and act upon” (Bui, 2020). However, in research literature seeking to operationalize the learning organization the two “disciplines” that Bui specifically singles out play in fact only cameo roles. For example, in the arguably most popular measurement scale for the learning organization, Dimensions of the Learning Organization Questionnaire (Marsick and Watkins, 2003), only two out of seven dimensions are focused on the individual. Traditionally, learning organization tools have been top-down with the agency at the leadership of the organization. Recently, however, interest has been rising for also developing bottom-up and multilevel tools and frameworks (Chou and Ramser, 2019).

Rigby and Ryan (2018), in their visionary overview of human resource development (HRD), go as far as to allude to a “Copernican Turn” as an emerging organizational paradigm. In contrast to “Pre-Copernican” approaches that rely on institutional levers and ‘command and control’ systems that management can activate to drive the desired behavior”, the “Copernican Turn” looks at individuals and their motivational and emotional factors. “For HRD to succeed, tools are needed that tap into the worker's *internal* frame of reference”.

In the HRD literature the need that Rigby and Ryan dramatize has indeed been noted for years – the need to link with “key individual variables” such as intention, goals, commitment and satisfaction (Peterson, 2004), “perceived investment in employee's development” (Lee and Bruvold, 2003) and “learning opportunities that nurture human expertise in organizations” (Shuck *et al.*, 2014, p. 239). This emphasis of quintessentially human factors is particularly pronounced when scholars meet head-on the fact, painfully obvious to practitioners, that an HRD program might be excellent as a plan and yet fail to deliver desired outcomes – because employees do not perceive the benefits. Key phenomena such as employee turnover intention or employee engagement hinge on how employees experience their peers, managers and organization, but managers and researcher alike have had a difficult time in conceptualizing and operationalizing the developmentally relevant

“human, all too human” parameters. Still, on the abstract level, the situation remains clear enough. As Chalofsky put it in his introduction to the authoritative *Handbook of Human Resource Development*, what is needed in the field is “a holistic approach to human development,” one that draws from “inner growth that is realized through interaction of self, context, and life experiences” (Chalofsky, 2014, p. xlv).

The call for more humanly-tuned grassroots-level informed conceptualizations is burning in the context of learning organizations, where the scholarly discourse tends to favor managerial structures that operates from top to bottom. Here the SI approach takes a sharp departure in favor of employees, individuals and human experience. The idea is to approach development through a discourse that does not speak about structures that only managers command but in terms of a discourse employees can understand.

For Senge, systems thinking never was not the cold and objectivistic model building of complex systems from without. As Senge makes clear in his 1993 key paper in *Human Resource Development Quarterly*, “systems thinking” amounts to “seeing relationships” that calls for such deeply human from-within qualities as “genuine caring” and “compassion” (Senge, 1993). It is here where the SI perspective is particularly mindful of Senge’s thinking for the benefit of organizational learning as a process. The SI approach takes caution neither to reify employees to objects nor systems to external entities. The SI perspective draws insight from modern relational, systems inspired empirical infant research and from its way of understanding the mother-infant dyad as the paradigmatic context of development (Hämäläinen and Saarinen, 2007b; Saarinen and Hämäläinen, 2010). In the mother-infant context, the baby is an active partner in the dyadic, bidirectional and co-creational system in which intra- and inter-subjective processes of development are intertwined (Beebe and Lachmann, 2005; Beebe *et al.*, 2005; Seligman, 2017).

The guiding intuition of the SI perspective concerns the factors that make humans succeed with and within wholes. With factors such as “systemic perception”, “attunement”, “positive engagement” and “effective responsiveness”, the SI perspective wishes to take the context seriously as a key determinant of successful action. The environment is brought to bear on the subject bidirectionally. In organizations, a key contextual factor is created by one’s fellow employees.

There is a long tradition in organizations to develop ways for managers and employees to get feedback of their actions, to avoid self-deception and to get a more realistic view of one’s behaviors for the benefit of right-directed development. Indeed, the use of multisource feedback, often called 360-degree feedback, in its various forms, is an established organizational practice (Maylett, 2009; Church *et al.*, 2019). The fact that leaders’ perceptions of their behaviors, along with the employees’ perceptions generally, might differ from those of others is a source of lively discussion. How the “rater bias” (Holzbach, 1978) and the “self-other agreement” affects various organizational outcomes is an issue that has relevance both theoretically and in practice (Atwater and Yammarino, 1997; Fleener *et al.*, 2010; Halverson *et al.*, 2005; Lee and Carpenter, 2018). When it comes to leadership, the issue becomes particularly relevant with results such as Jacobsen and Bøgh Andersen (2015) that indicate that at least in some cases, employee-perceived leadership appears to be a more useful metric than the leader’s own self-evaluation.

In this paper, we are interested if SI can also be evaluated by peers as perceived competence, especially *vis-à-vis* perceived job performance. We extend the notion of SI to perceptions of one’s colleagues in one’s organization and introduce a perceived SI measurement scale, adapting the factor structure introduced by the SI inventory of Törmänen *et al.* (2016). We study the relationship between the learning organization and organizational performance (Kim and Lu, 2019) by correlating perceived SI with perceived job performance, with a particular focus on people in a leadership position.

The new inventory is tested and validated by administering it through a web-based questionnaire to people working in the UK and USA. The subjects ( $N = 569$ ) included employees and managers in various organizations. The subjects were asked to evaluate two of their colleagues – one they felt was a “top performer” in their organization and one they felt was an “average performer.” The subjects were asked to evaluate the person in question regarding behaviors and features that related to SI, as well as how the person succeeded in her work performance. The large sample of 1,138 peer-evaluated colleagues allowed analyzing the results obtained in different professions, organizational positions and age groups, as well as for men and women.

## Method

### *Creating the perceived systems intelligence inventory*

We chose to develop the perceived SI inventory by adapting the self-report SI inventory developed in [Törmänen et al. \(2016\)](#) to a peer-evaluation context. Recognizing that some of the items might be more difficult to address as perceived items instead of self-report items, using the exact same factor structure allows for comparison and contrasting of the self-report and peer perceived SI measurements, and thus significantly widens the applicability of the inventory. Therefore, it was considered desirable to retain as much of the already identified eight-factor SI structure as possible.

The perceived SI inventory was created by revising the phrasings of the original inventory. The original “I [...]” format (“I contribute to the shared atmosphere in group situations”) was changed to a “My colleague [...]” format (“My colleague contributes to the shared atmosphere in group situations”). The resulting inventory of 32 items was screened in a pilot study, whose results were used to ensure that the new perceived versions were understood properly and that their answer distributions were not heavily skewed. Pilot results indicated that direct modification produced a well-functioning inventory with well-behaving items. The resulting inventory, as used in this study, is included in [Appendix](#).

### *Data and samples*

To gather a large, well-sampled set of colleague evaluations, individuals in the academic crowdsourcing platform [Prolific.ac](#) were invited to evaluate their own colleagues. The participants received monetary compensation of £1.00–£1.25 for participating in the study. Each participant was asked to evaluate two of his or her colleagues, one who they considered to be among the top 5% of performers in their organization and another who they considered a typical, average performer.

The subject filled the 32-item perceived SI inventory for both colleagues and gave an estimate of how well they felt the colleagues performed in his/her work. The SI questions were answered on a seven-point Likert scale from “never” to “always.” Performance was asked with the question “On a scale from 0 to 10, how well do you feel your colleague performs in his/her work?”, with the subject answering on a Likert scale. The data set was gathered during a number of smaller-scale questionnaire rounds. In later rounds, the following two additional performance questions were posed with the same scale: “On a scale of 0–10, how much does this colleague help other people succeed?” and “On a scale of 0–10, how much does this colleague contribute to a positive work climate?”

The subjects also described how well they knew the colleague (“We are close friends”; “Quite well”; “Only a little”) and how long they had been colleagues (“Less than 1 year”; “1–3 years”; “3–10 years”; “Over 10 years”). The questionnaire also asked for the colleague’s gender, age and position in their organization, and the participant’s gender and age.

The subjects were selected from a pool of participants who worked full-time, were residents of the UK or the USA and at least 25 years of age. In total, 569 people participated, resulting in 1,138 perceived SI evaluations. The summary statistics from the data set have been collected to [Table 1](#). The sampling strategy resulted in a roughly even split of men and women for both participants and colleagues, with a wide distribution of age groups, and with 44% of the colleagues being in managerial or supervisor positions.

**Results**

*Construct validity of perceived systems intelligence*

The self-report SI inventory uses factor scores of the eight SI factors to highlight systems intelligent behavior and to give suggestions and recommendations to the individual. To study whether the same eight-factor model can be used with perceived SI data, we replicate the confirmatory factor analysis process described by [Törmänen et al. \(2016\)](#) using our full data sample ( $N = 1,138$ ).

Construct validity is assessed by fitting a confirmatory factor analysis model using structural equation modeling ([Bollen, 1989](#)) to the data set, with the same 32-item 8-factor structure as the self-report SI inventory. Using the implementation of the R “sem” package ([Fox et al., 2020](#)), the resulting model has a chi-squared value of 1,831.4 with 436 degrees of freedom ( $p < 0.001$ ).

The eight-factor model has a good model fit as indicated by recommendations by [Hu and Bentler \(1999\)](#), with structural fit indices root mean square error of approximation 0.053 and standardized root mean squared residual 0.057. Additionally, the model outperforms a simple single factor model with all items loading to a single SI factor ( $\chi^2 = 2,241.3$ ,  $df = 464$ ,  $\chi^2$  difference  $p < 0.001$ ), showing that a multifactor structure is clearly preferable for describing the perceived SI data set.

These results indicate good construct validity for the eight-factor perceived SI inventory and suggest that it can be used with the same eight factors as the self-report SI inventory.

*Perceived systems intelligence and perceived work performance*

We calculate perceived SI factor scores as weighted averages of the structural equation model coefficients produced in the previous step. [Table 2](#) shows cross-correlations between

**Table 1.**  
Summary statistics  
for participants and  
peer-reviewed  
colleagues

Group	Participants	Colleagues
<i>Count</i>		
N	569	1,138
<i>Gender</i>		
Female	298 (52%)	549 (48%)
Male	268 (47%)	586 (51%)
N/A	3	3
<i>Age</i>		
<30	130	260
30–40	221	433
40–50	122	270
50–60	80	149
>60	14	26
N/A	2	0
<i>Role</i>		
Manager or supervisor		501 (44%)
Not manager or supervisor		623 (55%)

Factor	ATT	ATD	DIS	REF	WIS	ENG	EFF	Perceived performance	Helps others succeed	Contributes to a positive work climate
Systemic perception (PER)	0.70	0.62	0.80	0.85	0.85	0.81	0.87	0.79	0.75	0.74
Attunement (ATT)		0.58	0.65	0.75	0.78	0.82	0.64	0.55	0.65	0.76
Attitude (ATD)			0.58	0.62	0.67	0.63	0.66	0.58	0.55	0.66
Spirited discovery (DIS)				0.83	0.74	0.74	0.76	0.68	0.69	0.68
Reflection (REF)					0.83	0.80	0.79	0.71	0.71	0.72
Wise action (WIS)						0.81	0.81	0.72	0.73	0.80
Positive engagement (ENG)							0.74	0.69	0.75	0.82
Effective responsiveness (EFF)								0.75	0.73	0.69
SI factor average								0.78	0.78	0.82

**Table 2.** Correlations between SI factor scores and peer evaluated work performance

the SI factors and correlations between SI factor scores and perceived colleague performance. Additionally, the table shows the correlation between the average of all eight SI factor scores and perceived performance. All correlations are statistically significant at a level  $p < 0.001$ . Table 3 shows the average scores for the SI factors and performance questions.

Correlations are high, both within the SI factors and between SI factors and perceived work performance. This implies that participants see that the factors of perceived SI are closely linked to how they perceive high performance in a work environment. Especially the perceived SI factors of Systemic Perception and Effective Responsiveness have very strong correlations with perceived performance.

The strong link between factor scores and work performance is further highlighted in the scatter plot of Figure 1, which shows the average perceived SI factor score on the vertical axis and perceived performance on the horizontal axis. In general, colleague evaluations follow the regression line quite closely; in only a few cases do the two variables significantly differ.

*Alternative perspectives to performance*

In addition to the main performance evaluation question, some participants were also asked to answer the following two extra performance questions: “On a scale of 0–10, how much does this colleague help other people succeed?” and “On a scale of 0–10, how much does this colleague contribute to a positive work climate?” Table 2 shows also correlations between SI and these two questions.

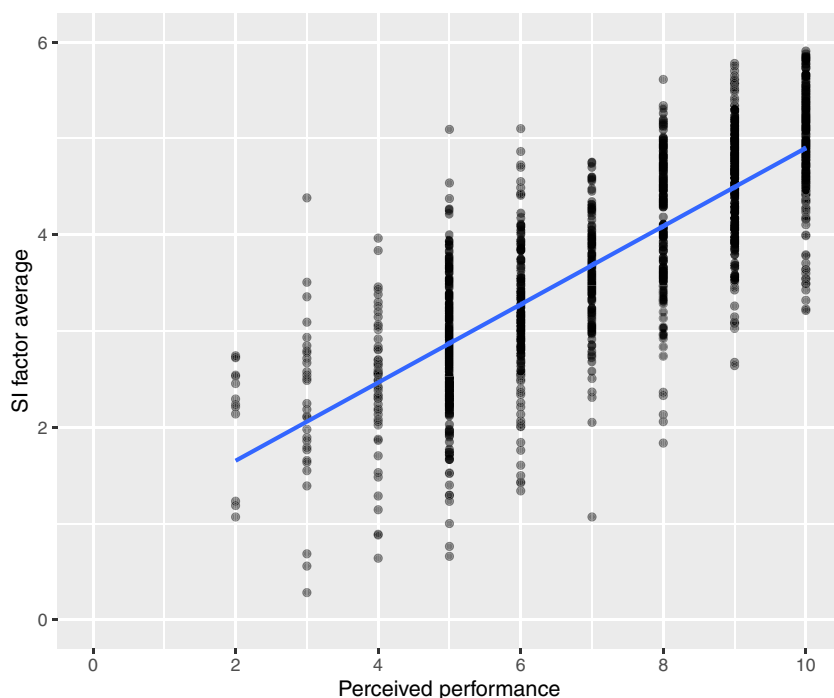
In general, the two alternative perspectives show similar results to perceived performance; correlations between perceived SI factors and the performance evaluations are high. Some of the most significant differences related to the more interpersonal factors of perceived SI (Attunement and Positive Engagement), which correlate strongly with contributing to a positive work climate. On the other hand, the more general systems thinking factors of systemic perception and effective responsiveness have a stronger link to direct perceived performance.

*Distribution of perceived systems intelligence factor scores for top, high and lower performing individuals*

Figure 2 presents histograms of perceived SI scores for managers and non-managers for each SI factor. The histograms are shown as cumulative bar charts with the evaluated

**Table 3.**  
Average scores for SI factors and performance questions for all participants, managers and non-managers

Score	All (N = 1,138)	Managers (N = 501)	Non-managers (N = 637)
<i>Perceived SI (0–6)</i>			
Systemic perception (PER)	3.87	4.22	3.59
Attunement (ATT)	4.08	4.18	4.00
Attitude (ATD)	3.36	3.63	3.15
Spirited discovery (DIS)	3.57	3.89	3.32
Reflection (REF)	3.63	3.90	3.42
Wise action (WIS)	3.86	4.12	3.66
Positive engagement (ENG)	3.69	4.01	3.43
Effective responsiveness (EFF)	3.89	4.27	3.59
<i>Performance (0–10)</i>			
Perceived performance	7.18	7.88	6.63
Helps others succeed	6.49	6.99	6.04
Contributes to a positive work climate	6.66	6.88	6.45



**Figure 1.** Colleagues (N = 1,133) evaluated by work performance and SI factor score average. Line shows the linear regression of the two variables

colleagues split into three color-coded groups based on their perceived work performance evaluation (0–5, 6–8 and 9–10).

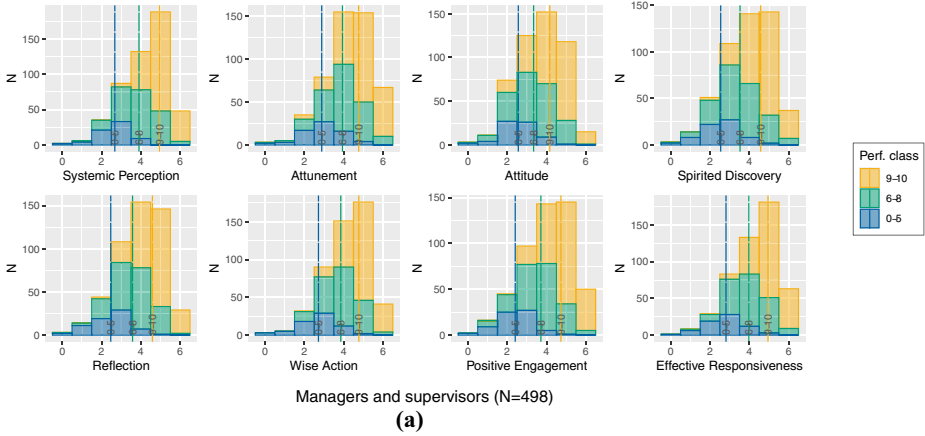
As the figures show, higher perceived performance and higher SI scores go closely hand in hand in all of the eight perceived SI factors. Especially for systemic perception and effective responsiveness, the two most strongly correlating factors in [Table 2](#), nearly all managers perceived as top performing score in the upper end of the perceived SI subscales.

There are also clear differences between managers and non-managers. Comparatively, a larger portion of managers and supervisors belong to the top and high-performance categories. As shown in [Table 3](#), managers and supervisors score higher in all eight factors of perceived SI and all three performance questions. The largest SI differences, effective responsiveness and systemic perception are also distinct visually in the statistical peaks of the distributions in [Figure 2](#).

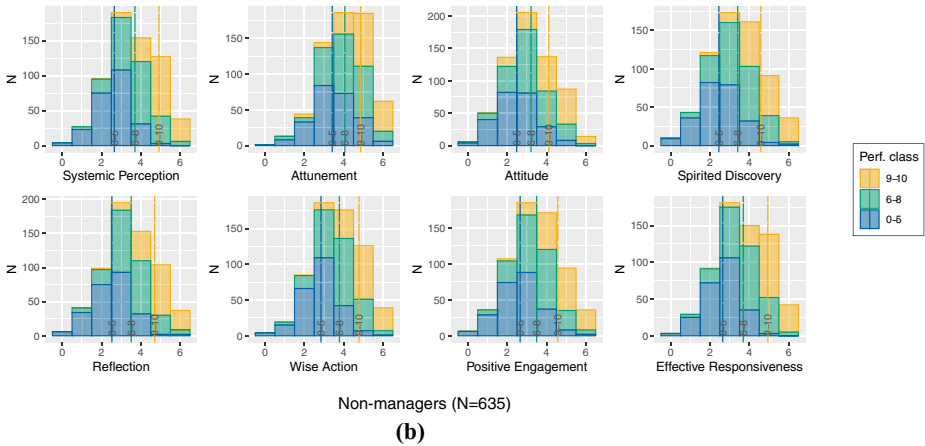
#### *Profiles of systems intelligent perceived managers*

[Figure 3](#) shows answer distributions to each questionnaire item as violin (distribution) plots for colleagues in supervisory or managerial positions. The figures are laid out so that each perceived SI factor is in its own row. These figures are especially useful to studying which of the questionnaire items seem to be particularly important to top-performing managers, and in which items also lower evaluations are common.

Essentially, these figures show a more fine-grained view of the distributions shown in [Figure 2](#). Some items, such as “My colleague easily grasps what is going on,” seem to be strong requirements of high performance; there are virtually no top-performing managers that receive low marks on the question.



**Figure 2.** SI score distributions for colleagues belonging in different performance classes for question “On a scale from 0 to 10, how well do you feel your colleague performs in his/her work?”. Horizontal lines denote averages for each performance class

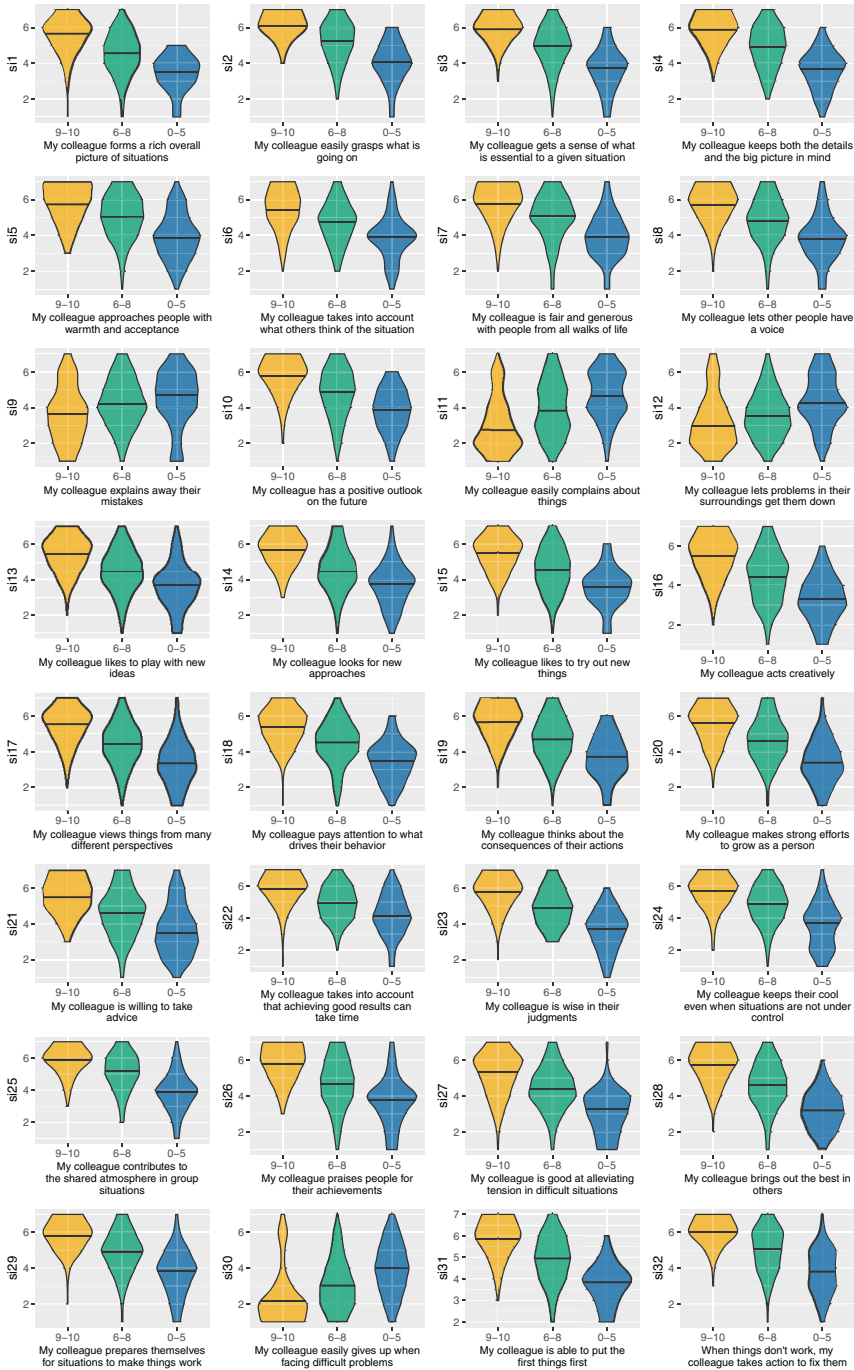


*Relationship between background variables and perceived systems intelligence*

We use one-way analysis of variance to study whether different answers to background variables are linked to different levels of total perceived SI (calculated as the average of the eight perceived SI factor scores). The rejection of an analysis of variance null hypothesis implies that participants are not sampled from a common population, but rather that perceived SI evaluations and the background variable correlate in some way.

Table 4 shows results for various background variables, including a broad industry grouping of technological, educational, manufacturing and other companies. The analysis of variance tests were carried out with Type III sums of squares using the R “car” package (Fox and Weisberg, 2019).

As Table 4 shows, only a few background variables are linked to the perceived SI assessment. Most notably, colleagues in manager/supervisory position differ greatly from other colleagues, and colleagues that the participant is closely acquainted with are evaluated differently from those the participant is less acquainted with. Additionally, colleague age group and acquaintance time with a colleague have smaller links, though at the level that



**Figure 3.** Item-by-item answer distributions based on perceived performance score classes for managers and supervisors (N = 498)

Bonferroni corrections would be used to avoid false positives, neither would be statistically significant.

The analysis of variance results imply that perceived SI evaluations are not strongly dependent on many common background variables, such as gender, age, organization size or industry, and therefore, perceived SI appears to have generic applicability and similar behavior in most common cases. In applying perceived SI, care should likely only be taken on avoiding close acquaintances from evaluating each other.

**Discussion**

The perceived SI uses colloquial phrases as opposed to structural or semi-theoretical discourse. As a result, the inventory proposed here supports approaches that seek to develop an organization from people-centered perspectives and look for opportunities at developing the organization from the “bottom up” instead of the more classic “top down” approach. As such, it can serve frameworks such as the multilevel model of organizational learning proposed by [Chou and Ramser \(2019\)](#), which emphasizes the upwards helping, psychological empowerment and voice behavior of employees. As Chou and Ramser note, there are few tools and frameworks available for the “bottom up” and individual-level development of learning organizations. The perceived SI inventory helps to fill this niche as likely the first peer evaluation tool in the field.

The question of leadership in a learning organization was raised already early in the seminal paper by [Bass \(2000\)](#). Empirical evidence in the current paper suggests a strong correlation between high perceived SI scores and perceived performance for managers. The availability of a peer evaluation tool for SI can help the leader in finding improvement opportunities, and to recognize and avoid destructive “systems of holding back” ([Hämäläinen and Saarinen, 2007a; Sasaki et al., 2015](#)).

Many aggregates and measurements in organizational and leadership research call for assessments that are difficult for employees to peer evaluate. Based on the results presented here, the perceived SI inventory seems to be one way of evaluating relevant-to-all behavior in a way that is easily discussable and directly comprehensible while at the same time relating to perceived performance. The development could be aided by the stages of SI identified by [Jones and Corner \(2012\)](#). Note that the theory of empathetic leadership by [Kock et al. \(2019\)](#) parallels in many respects SI; empathetic leadership has positive effects on job satisfaction and follower performance.

**Table 4.**  
Analysis of variance  
test results for  
different background  
variables

Variable	df	F	p	sig
Colleague gender	1	3.7243	0.054	
Colleague age group	5	2.8372	0.015	*
Colleague is a manager/supervisor	1	64.254	0.000	***
Acquaintance level with a colleague	2	40.172	0.000	***
Acquaintance time with a colleague	4	3.4126	0.009	**
My gender	1	2.4075	0.121	
My age group	4	1.2414	0.292	
My time in organization	4	0.2395	0.916	
Organization size	4	0.1136	0.978	
Industry (tech/edu/manufacturing/other)	3	0.1885	0.904	

**Notes:** \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .  $p$ -values do not have Bonferroni correction

The items of SI call out to action and behaviors that anybody irrespective of her position can perceive, appreciate and potentially improve. This indicates that the SI perspective is a useful framework for an organization to adopt for its developmental discourse on any level of the organization. Not only does SI correlate with individual work performance but also it relates to how much a person supports others and the workspace environment; a systems intelligent worker is also one who builds a positive atmosphere in the workplace.

The factors of SI seem to be clearly visible to one's colleagues and at the same time, they closely relate to how employees perceive others' performance. However, the majority of the SI items pointedly talk about the "soft" aspects of performance. This highlights the human dimension called out by HRD professionals and by Rigby and Ryan with their "Copernican Turn." Integrating the SI perspective with more reifying performance indicators, a leader will likely be encouraged to pay attention to SI-related skills in herself and in her personnel. The way employees perceive their peers' performance is certainly a concern for a leader. An employee's performance might be objectively good, but if peers perceive it as weak, self-generated problems can be predicted for the whole. Versatile, well-rounded and humanly rich development thinking will carry an organization further than the narrow performance focus that employee experience as reducing them to objects.

As the perceived SI inventory is a rather lightweight instrument of 32 Likert-scale items, it can have wide applicability for different organizational development and improvement purposes. For example, the perceived SI inventory could be included as a component of a 360-degree feedback questionnaire, providing a viewpoint to how an employee's organizational and systems skills are perceived. The evaluation could also be relatively easily repeated later with the same individuals to study changes in perceived SI factor scores.

The perceived SI inventory provides many opportunities for developing organizations and teams. For example, it can be used as an organization-wide or team-wide intervention, where all members give perceived SI evaluations on their closest colleagues, helping individuals identify their strengths and weaknesses on the eight SI factors. The results could be further connected to the self-report SI inventory of [Törmänen et al. \(2016\)](#), highlighting possible differences between self-perceptions and colleague perceptions of SI. [Figures 2 and 3](#) show two suggestions to how SI factor score distributions can be visualized and allow for the easy showing of how an individual's own scores are positioned next to the overall distribution.

In the results reported here on SI, it is very rare for there to be a person who scores low in perceived SI and still is perceived to generate good performance or vice versa. Managers receive higher evaluations in all perceived SI factors and based on the analysis-of-variance test, and managerial position is the strongest background variable affecting an individual's perceived SI evaluation.

Thus, the perceived SI inventory can have the potential to serve as a powerful tool for leadership development. The inventory and its factors can be used as part of coaching programs, for example, by focusing on any gaps an individual has in his/her SI capabilities or they can be taken as concepts and vocabulary for more informal dialogue within the workplace, optionally supported by other tools such as design games ([Hämäläinen et al., 2020](#)).

## Conclusions

Based on confirmatory factor analysis results, the perceived SI inventory has good factorial validity using the original self-report SI inventory factor structure. Thus, the eight SI factors can thus be used to describe perceived SI.

The results show that all perceived SI factors correlate strongly with subjective evaluations of work performance. When studying top-performing individuals and especially top-performing managers, the effect is especially pronounced with the perceived SI factors Systemic Perception and Effective Responsiveness.

When comparing managers to other employees, managers tend to have higher perceived SI. perceived SI is also strongly linked to perceived performance in managers, and thus seems to be equally or even more important for managers than for other employees. Thus, results indicate that managers and leaders could benefit from coaching and tools that help them develop their SI capabilities.

Based on the relationship between the perceived SI factors and background variables perceived SI seems to be generic; there are only minor differences between genders, age groups or between different industry sectors. This result is maintained for both employees and managers. Indeed, it seems that systems intelligent behavior and leadership is similar no matter the place.

### References

- Atwater, L.E. and Yammarino, F.J. (1997), "Self-other rating agreement: a review and model", *Research in Personnel and Human Resources Management*, Vol. 15, pp. 121-174.
- Bass, B.M. (2000), "The future of leadership in learning organizations", *Journal of Leadership Studies*, Vol. 7 No. 3, pp. 18-40, doi: [10.1177/107179190000700302](https://doi.org/10.1177/107179190000700302).
- Beebe, B. and Lachmann, F.M. (2005), *Infant Research and Adult Treatment: Co-Constructing Interactions*, Routledge.
- Beebe, B., Knoblauch, S., Rustin, J. and Sorter, D. (2005), "Forms of intersubjectivity in infant research and adult treatment", Other Press.
- Bollen, K.A. (1989), *Structural Equations with Latent Variables*, John Wiley and Sons.
- Bui, H. (2020), "From the fifth discipline to the new revolution: what we have learnt from senge's ideas over the last three decades", *The Learning Organization*, Vol. 27 No. 6, pp. 489-498, doi: [10.1108/TLO-04-2020-0062](https://doi.org/10.1108/TLO-04-2020-0062).
- Chalofsky, N.E. (2014), "Introduction: the profession and the discipline", in Chalofsky, N.E., Rocco, T.S. and Morris, M.L. (Eds), *Handbook of Human Resource Development*, John Wiley and Sons, pp. 37-55.
- Chou, S.Y. and Ramser, C. (2019), "A multilevel model of organizational learning", *The Learning Organization*, Vol. 26 No. 2, pp. 132-145, doi: [10.1108/TLO-10-2018-0168](https://doi.org/10.1108/TLO-10-2018-0168).
- Church, A.H., Bracken, D.W., Fleenor, J.W. and Rose, D.S. (Eds). (2019), *Handbook of Strategic 360 Feedback*, Oxford University Press.
- Fleenor, J.W., Smither, J.W., Atwater, L.E., Braddy, P.W. and Sturm, R.E. (2010), "Self-other rating agreement in leadership: a review", *The Leadership Quarterly*, Vol. 21 No. 6, pp. 1005-1034, doi: [10.1016/j.leaqua.2010.10.006](https://doi.org/10.1016/j.leaqua.2010.10.006).
- Fox, J. and Weisberg, S. (2019), *An R Companion to Applied Regression (Third)*, Sage, available at: <https://socialsciences.mcmaster.ca/jfox/Books/Companion/>
- Fox, J., Nie, Z. and Byrnes, J. (2020), "Sem: structural equation models (R package version 3.1-11)", available at: <https://cran.r-project.org/package=sem>
- Halverson, S.K., Tonidandel, S., Barlow, C.B. and Dipboye, R.L. (2005), "Self-other agreement on a 360-degree leadership evaluation", in Reddy, S. (Ed.) *Multi-Source Performance Assessment: Perspective and Insights*, ICFAI University Press, Hyderabad, pp. 125-144.
- Hämäläinen, R.P. and Saarinen, E. (2006), "Systems intelligence: a key competence in human action and organizational life", *Reflections: The SoL Journal*, Vol. 7 No. 4, pp. 191-201.

- Hämäläinen, R.P. and Saarinen, E. (2007a), "Systems intelligent leadership", in Hämäläinen, R.P. and Saarinen, E. (Eds), *Systems Intelligence in Leadership and Everyday Life*, Helsinki University of Technology, pp. 3-38.
- Hämäläinen, R.P. and Saarinen, E. (2007b), "The way forward with systems intelligence", in Hämäläinen, R.P. and Saarinen, E. (Eds), *Systems Intelligence in Leadership and Everyday Life*, Helsinki University of Technology, pp. 295-306.
- Hämäläinen, R.P., Jones, R. and Saarinen, E. (2014), "Being better better", Aalto University. [http://systemsintelligence.aalto.fi/being\\_better\\_better/](http://systemsintelligence.aalto.fi/being_better_better/)
- Hämäläinen, R.P., Saarinen, E. and Törmänen, J. (2018), "Systems intelligence: a core competence for next-generation engineers?", *2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, pp. 641-644, doi: [10.1109/TALE.2018.8615247](https://doi.org/10.1109/TALE.2018.8615247).
- Hämäläinen, R.P., Kumpulainen, K.-R., Harviainen, J.T. and Saarinen, E. (2020), "Design gaming for learning systems intelligence in socio-emotional systems", *Systems Research and Behavioral Science*, pp. 1-5, doi: [10.1002/sres.2750](https://doi.org/10.1002/sres.2750).
- Harviainen, J.T., Hämäläinen, R. and Saarinen, E. (2021), "System intelligence as an organizational approach for service designers", *Touchpoint: The Journal of Service Design*, Vol. 12 No. 2, pp. 16-29.
- Holzbach, R.L. (1978), "Rater bias in performance ratings: superior, self-, and peer ratings", *Journal of Applied Psychology*, Vol. 63 No. 5, pp. 579-588, doi: [10.1037/0021-9010.63.5.579](https://doi.org/10.1037/0021-9010.63.5.579).
- Hu, L. and Bentler, P.M. (1999), "Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives", *Structural Equation Modeling: A Multidisciplinary Journal*, Vol. 6 No. 1, pp. 1-55, doi: [10.1080/10705519909540118](https://doi.org/10.1080/10705519909540118).
- Jacobsen, C.B. and Bøgh Andersen, L. (2015), "Is leadership in the eye of the beholder? A study of intended and perceived leadership practices and organizational performance", *Public Administration Review*, Vol. 75 No. 6, pp. 829-841, doi: [10.1111/puar.12380](https://doi.org/10.1111/puar.12380).
- Jones, R. and Corner, J. (2012), "Stages and dimensions of systems intelligence", *Systems Research and Behavioral Science*, Vol. 29 No. 1, pp. 30-45, doi: [10.1002/sres.1090](https://doi.org/10.1002/sres.1090).
- Jumisko-Pyykkö, S., Viita-Aho, T., Tiilikainen, E. and Saarinen, E. (2021), "Towards systems intelligent approach in empathic design", *Academic Mindtrek 2021 (Mindtrek '21), 1-3 June 2021, Tampere/Virtual, Finland*, doi: [10.1145/3464327.3464370](https://doi.org/10.1145/3464327.3464370).
- Kim, K. and Lu, Z. (2019), "Learning organization and organizational performance", in Örtenblad, A.R. (Ed.), *The Oxford Handbook of the Learning Organization*, Oxford University Press, pp. 332-346, doi: [10.1093/oxfordhb/9780198832355.013.18](https://doi.org/10.1093/oxfordhb/9780198832355.013.18).
- Kock, N., Mayfield, M., Mayfield, J., Sexton, S. and De La Garza, L.M. (2019), "Empathetic leadership: how leader emotional support and understanding influences follower performance", *Journal of Leadership and Organizational Studies*, Vol. 26 No. 2, pp. 217-236, doi: [10.1177/1548051818806290](https://doi.org/10.1177/1548051818806290).
- Lee, C.H. and Bruvold, N.T. (2003), "Creating value for employees: investment in employee development", *The International Journal of Human Resource Management*, Vol. 14 No. 6, pp. 981-1000, doi: [10.1080/0958519032000106173](https://doi.org/10.1080/0958519032000106173).
- Lee, A. and Carpenter, N.C. (2018), "Seeing eye to eye: a meta-analysis of self-other agreement of leadership", *The Leadership Quarterly*, Vol. 29 No. 2, pp. 253-275, doi: [10.1016/j.leaqua.2017.06.002](https://doi.org/10.1016/j.leaqua.2017.06.002).
- Luoma, J., Hämäläinen, R.P. and Saarinen, E. (2008), "Perspectives on team dynamics: meta learning and systems intelligence", *Systems Research and Behavioral Science*, Vol. 25 No. 6, pp. 757-767, doi: [10.1002/sres.905](https://doi.org/10.1002/sres.905).
- Luoma, J., Hämäläinen, R.P. and Saarinen, E. (2011), "Acting with systems intelligence: integrating complex responsive processes with the systems perspective", *Journal of the Operational Research Society*, Vol. 62 No. 1, pp. 3-11, doi: [10.1057/jors.2009.175](https://doi.org/10.1057/jors.2009.175).

- Marsick, V.J. and Watkins, K.E. (2003), "Demonstrating the value of an organization's learning culture: the dimensions of the learning organization questionnaire", *Advances in Developing Human Resources*, Vol. 5 No. 2, pp. 132-151, doi: [10.1177/1523422303005002002](https://doi.org/10.1177/1523422303005002002).
- Martela, F. and Saarinen, E. (2013), "The systems metaphor in therapy discourse: introducing systems intelligence", *Psychoanalytic Dialogues*, Vol. 23 No. 1, pp. 80-101, doi: [10.1080/10481885.2013.754281](https://doi.org/10.1080/10481885.2013.754281).
- Maylett, T. (2009), "360-Degree feedback revisited: the transition from development to appraisal", *Compensation and Benefits Review*, Vol. 41 No. 5, pp. 52-59, doi: [10.1177/0886368709337922](https://doi.org/10.1177/0886368709337922).
- Örtenblad, A. (2018), "What does 'learning organization' mean?", *The Learning Organization*, Vol. 25 No. 3, pp. 150-158, doi: [10.1108/TLO-02-2018-0016](https://doi.org/10.1108/TLO-02-2018-0016).
- Peterson, S.L. (2004), "Toward a theoretical model of employee turnover: a human resource development perspective", *Human Resource Development Review*, Vol. 3 No. 3, pp. 209-227, doi: [10.1177/1534484304267832](https://doi.org/10.1177/1534484304267832).
- Rigby, C.S. and Ryan, R.M. (2018), "Self-determination theory in human resource development: new directions and practical considerations", *Advances in Developing Human Resources*, Vol. 20 No. 2, pp. 133-147, doi: [10.1177/1523422318756954](https://doi.org/10.1177/1523422318756954).
- Saarinen, E. and Hämäläinen, R.P. (2010), "The originality of systems intelligence", In *Essays on Systems Intelligence*, Aalto University, School of Science and Technology, Systems Analysis Laboratory, pp. 9-26.
- Saarinen, E. and Lehti, T. (2014), "Inducing mindfulness through life-philosophical lecturing", in Ie, A., Ngnoumen, C.T. and Langer E.J. (Eds), *The Wiley Blackwell Handbook of Mindfulness*, John Wiley and Sons, pp. 1105-1131.
- Saarinen, E. and Hämäläinen, R.P. (2004), "Systems intelligence: connecting engineering thinking with human sensitivity", In *Systems Intelligence – Discovering a Hidden Competence in Human Action and Organizational Life*, Helsinki University of Technology, pp. 1-29.
- Sasaki, Y. (2017), "A note on systems intelligence in knowledge management", *The Learning Organization*, Vol. 24 No. 4, pp. 236-244, doi: [10.1108/TLO-09-2016-0062](https://doi.org/10.1108/TLO-09-2016-0062).
- Sasaki, Y., Hämäläinen, R.P. and Saarinen, E. (2015), "Modeling systems of holding back as hypergames and their connections with systems intelligence", *Systems Research and Behavioral Science*, Vol. 32 No. 6, pp. 593-602, doi: [10.1002/sres.2276](https://doi.org/10.1002/sres.2276).
- Seligman, S. (2017), *Relationships in Development: Infancy, Intersubjectivity, and Attachment*, Routledge, doi: [10.4324/9780203850824](https://doi.org/10.4324/9780203850824)
- Senge, P.M. (1990), *The Fifth Discipline: The Art and Science of the Learning Organization*, Doubleday/Currency.
- Senge, P.M. (1993), "Transforming the practice of management", *Human Resource Development Quarterly*, Vol. 4 No. 1, pp. 5-32, doi: [10.1002/hrdq.3920040103](https://doi.org/10.1002/hrdq.3920040103).
- Shuck, B., Twyford, D., Reio, T.G. and Shuck, A. (2014), "Human resource development practices and employee engagement: examining the connection with employee turnover intentions", *Human Resource Development Quarterly*, Vol. 25 No. 2, pp. 239-270, doi: [10.1002/hrdq.21190](https://doi.org/10.1002/hrdq.21190).
- Törmänen, J., Hämäläinen, R.P. and Saarinen, E. (2016), "Systems intelligence inventory", *The Learning Organization*, Vol. 23 No. 4, pp. 218-231, doi: [10.1108/TLO-01-2016-0006](https://doi.org/10.1108/TLO-01-2016-0006).
- Törmänen, J., Hämäläinen, R.P. and Saarinen, E. (2021), "On the systems intelligence of a learning organization: introducing a new measure", *Human Resource Development Quarterly*, Advanced online publication, doi: [10.1002/hrdq.21455](https://doi.org/10.1002/hrdq.21455).
- Törmänen, J. (2021), "Systems intelligence – measurement and modeling", Doctoral dissertation, Aalto University, available at: <http://urn.fi/URN:ISBN:978-952-64-0468-4>

#	Factor	Direction	Item
1	Systemic perception	+	My colleague forms a rich overall picture of situations
2	Systemic perception	+	My colleague easily grasps what is going on
3	Systemic perception	+	My colleague gets a sense of what is essential to a given situation
4	Systemic perception	+	My colleague keeps both the details and the big picture in mind
5	Attunement	+	My colleague approaches people with warmth and acceptance
6	Attunement	+	My colleague takes into account what others think of the situation
7	Attunement	+	My colleague is fair and generous with people from all walks of life
8	Attunement	+	My colleague lets other people have a voice
9	Attitude	-	My colleague explains away their mistakes
10	Attitude	+	My colleague has a positive outlook on the future
11	Attitude	-	My colleague easily complains about things
12	Attitude	-	My colleague lets problems in their surroundings get them down
13	Spirited discovery	+	My colleague likes to play with new ideas
14	Spirited discovery	+	My colleague looks for new approaches
15	Spirited discovery	+	My colleague likes to try out new things
16	Spirited discovery	+	My colleague acts creatively
17	Reflection	+	My colleague views things from many different perspectives
18	Reflection	+	My colleague pays attention to what drives their behavior
19	Reflection	+	My colleague thinks about the consequences of their actions
20	Reflection	+	My colleague makes strong efforts to grow as a person
21	Wise Action	+	My colleague is willing to take advice
22	Wise Action	+	My colleague takes into account that achieving good results can take time
23	Wise action	+	My colleague is wise in their judgments
24	Wise action	+	My colleague keeps their cool even when situations are not under the control
25	Positive engagement	+	My colleague contributes to the shared atmosphere in group situations
26	Positive engagement	+	My colleague praises people for their achievements
27	Positive engagement	+	My colleague is good at alleviating tension in difficult situations
28	Positive engagement	+	My colleague brings out the best in others
29	Effective responsiveness	+	My colleague prepares themselves for situations to make things work
30	Effective responsiveness	-	My colleague easily gives up when facing difficult problems
31	Effective responsiveness	+	My colleague is able to put the first things first
32	Effective responsiveness	+	When things don't work, my colleague takes action to fix them

**Table A1.**  
Perceived SI  
inventory items and  
factors

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