Ergonomics

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/terg20

The role of social support in human-automation interaction

Juergen Sauer, Andreas Sonderegger & Norbert K. Semmer

To cite this article: Juergen Sauer, Andreas Sonderegger & Norbert K. Semmer (27 Feb 2024): The role of social support in human-automation interaction, Ergonomics, DOI: 10.1080/00140139.2024.2314580

To link to this article: https://doi.org/10.1080/00140139.2024.2314580

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

Published online: 27 Feb 2024.

Submit your article to this journal

Article views: 114

View related articles

View Crossmark data

source: https://doi.org/10.48350/193575 | downloaded: 15.5.2024

Full Terms & Conditions of access and use can be found at https://www.tandfonline.com/action/journalInformation?journalCode=terg20

ERGONOMICS
https://doi.org/10.1080/00140139.2024.2314580

Taylor & Francis
Taylor & Francis Group

REVIEW ARTICLE

OPEN ACCESS Check for updates

The role of social support in human-automation interaction

Juergen Sauer[a], Andreas Sonderegger[a,b] and Norbert K. Semmer[c]

[a]Department of Psychology, University of Fribourg, Fribourg, Switzerland; [b]Business School, Institute for New Work, Bern University of Applied Sciences, Bern, Switzerland; [c]Department of Psychology, University of Bern, Bern, Switzerland

ABSTRACT

This theoretical article examines the concept of social support in the context of human-automation interaction, outlining several critical issues. We identified several factors that we expect to influence the consequences of social support and to what extent it is perceived as appropriate (e.g. provider possibilities, recipient expectations), notably regarding potential threats to self-esteem. We emphasise the importance of performance (including extra-role performance) as a potential outcome, whereas previous research has primarily concentrated on health and well-being. We discuss to what extent automation may provide different types of social support (e.g. emotional, instrumental), and how it differs from human support. Finally, we propose a taxonomy of automated support, arguing that source of support is not a binary concept. We conclude that more empirical work is needed to examine the multiple effects of social support for core performance indicators and extra-role performance and emphasise that there are ethical questions involved.

PRACTITIONER SUMMARY

This theoretical article examines the role of automated social support given the increasing ability of automated systems. It concludes that it seems likely that automated systems may be perceived as supportive if they conform to pertinent criteria for design. However, empirical studies are needed to assess the impact of the complex interplay of humans and automation being involved together in the design and provision of social support.

ARTICLE HISTORY
Received 14 March 2023
Accepted 27 January 2024

KEYWORDS
Social support; automation; human-machine interaction; performance; extra-role performance

1. Introduction

Over a number of years, the increasing capabilities of automated systems have offered a range of new possibilities for providing assistance to the human operator (e.g. in the form of decision support systems; Liu et al. 2010). While decision support systems and other forms of operator support have received a great deal of interest in research, technical systems providing social support to operators (be it in the form of instrumental or emotional support) have not yet received much attention. While the provision of human social support (e.g. by supervisors or fellow operators) is much more common, recent developments in the domain of robotics and artificial intelligence indicate that automated systems might also be perceived as a source of social support (e.g. Broadwell, Davis, and Yoon 2022). Overall, this issue is likely to gain in importance since, over the years to come, automation is expected to reduce the number of human colleagues who are all potential sources of social support but would no longer be available in this important role. This raises the question to what extent automation can compensate for this loss of sources of human support. The increasing capabilities of automation might also allow a more systematic utilisation of automated support, in which the process of providing support could be started in two ways, either by the automation (provider-initiated support) or by the operator in need of support (recipient-initiated support). The underlying principles of these two forms of initiating support bear some resemblance to the classic conceptual distinction between adaptive and adaptable automation (Parasuraman 2000), which refers to the question of which agent (i.e. automation, human) should have what level of control. Such questions are important and will be dealt with in the present work.

CONTACT Juergen Sauer juergen.sauer@unifr.ch Department of Psychology, University of Fribourg, Rue de Faucigny 2, 1700 Fribourg, Switzerland
© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

In this article, we will focus on social support at work, though automated support has also been examined in other contexts, including self-management tools (Sage et al. 2017) or socially assistive robots (Schneider, Goerlich, and Kummert 2017).

When we use the term automation in this article, we refer to different types of automated systems, such as computers, (self-learning) algorithms, robots, or handheld interactive devices such as smartphones. It is acknowledged that there may be differences between these artefacts in their effectiveness of support provision but, for reasons of simplicity, these differences will not undergo a systematic analysis in this article.

In this article, we aim to address five issues. First, we will analyse the different aspects of social support discussed in the literature, such as types of support (notably instrumental and emotional support), sources (notably humans versus automated systems), and forms (perceived versus received support), pointing to the danger of support representing a threat to self-esteem. Second, we will argue that more attention needs to be given to the impact on performance (including extra-role performance) given that previous research on social support has typically focused on health and well-being as outcome variables. Third, we will outline the effects of social support, pointing out possible differences between human and automated support. Fourth, given the vast and growing capabilities of automated systems, we will explore the future role of automated aids in giving social support, resulting in a taxonomy of social support design. Fifth, we will argue that source of support is not a binary concept since support can be provided by humans and automation together with various degrees of involvement of each party.

2. The concept of social support

2.1. History, definition and overview

Early mentions of the concept of social support date back a long time (e.g. Allen and Levine 1968). Since then, social support has become an important concept in work psychology (e.g. Kossek et al. 2011; Mathieu, Eschleman, and Cheng 2019, Viswesvaran, Sanchez, and Fisher 1999) and, though to a much lesser extent, in human factors and ergonomics (e.g. Woods 2005).

Social support can be defined as 'helping behaviours [that] provide socio-emotional and task-relevant resources' (Mathieu, Eschleman, and Cheng 2019, p. 387), although the specific terms used may vary (e.g. French et al. 2018, refer to psychological or material resources). From the perspective of the recipient, social support has been defined as 'information leading the subject to believe that he is cared for and loved, esteemed, and a member of a network of mutual obligations' (Cobb 1976, p. 300). Social support is characterised by a certain antagonism to social stress, which refers to poor social interactions with other humans such as supervisors or fellow operators, resulting in negative effects (Gerhardt et al. 2021; Sonnentag and Frese 2013). In contrast, social support is expected to have a positive effect (Semmer et al. 2008; Uchino 2004). Both have in common that they are not only relevant in the context of human-human interaction but also in human-automation interaction (e.g. when the automation socially excludes a human or provides negative and discouraging feedback to a human). A more thorough account of the nature of automation-induced social stress is presented elsewhere (Sauer et al. 2019; 2023a).

2.2. Types and sources of social support

In the literature on social support, several aspects are typically distinguished, such as type of support (notably emotional versus instrumental support; Mathieu, Eschleman, and Cheng 2019; Shakespeare-Finch and Obst 2011), source (e.g. work environment, family, or friends; Barling, MacEwen, and Pratt 1988), and form (perceived versus received; Uchino 2004). Figure 1 provides an overview of the conceptual model with the different elements that are important when providing social support.

Corresponding to the definition in terms of socio-emotional and task-relevant resources, the most prominent distinction in the literature refers to emotional versus instrumental support (e.g. House, Umberson, and Landis 1988; Morelli et al. 2015). Emotional support aims to improve the subjective state of the recipient, notably by making them feel valued and cared for. Instrumental support refers to task-oriented action, such as providing tangible help or advice on how to solve a problem. In addition to this basic distinction comprising two categories, more refined classification systems were also proposed (e.g. material, behavioural, guidance, intimate, feedback, and positive social interaction; Barrera and Ainlay 1983; Cutrona and Suhr 1992; Holt-Lunstad and Uchino 2015). These can be regarded as nuanced facets of the basic distinction between instrumental and emotional support. This basic distinction would also apply to automation, which could provide instrumental support (e.g. an expert system provides advice on how to solve a problem the operator had difficulties in dealing with) as well as emotional support (e.g.

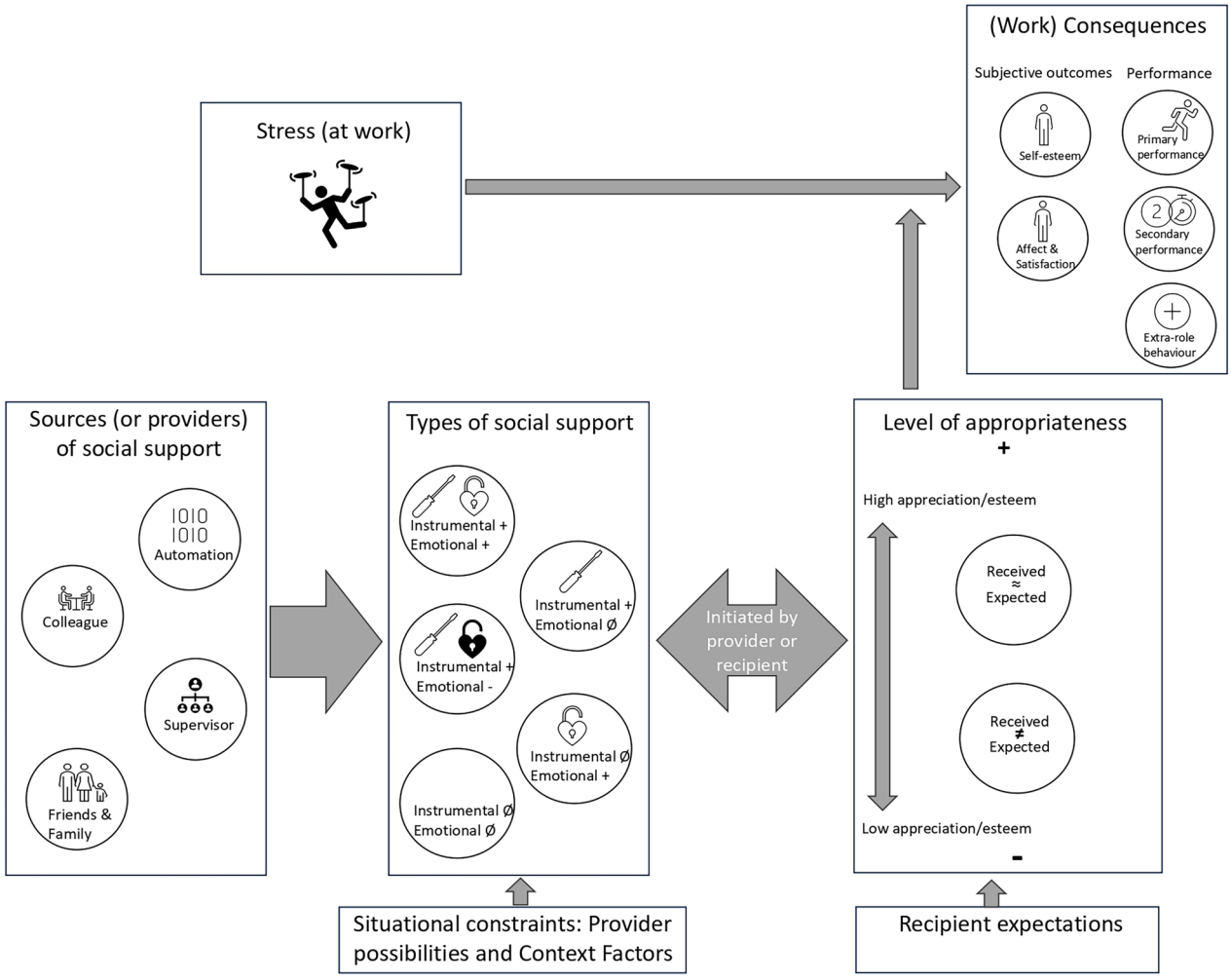

Figure 1. Overview of conceptual model of social support and its constituting elements.

algorithm provides encouragement to human operator during problem-solving).

Based on the distinction between emotional and instrumental support, different combinations of these two types of support are presented in Table 1. It combines two levels of instrumental support with three levels of emotional support. Whereas for instrumental support only two levels are defined (i.e. support present or absent; *INS* + versus *INS Ø*), for emotional support three levels are conceivable (i.e. *EMO +, EMO Ø, EMO –*) referring to 'positive', 'neutral' and 'negative' emotional support in the form of devaluing comments. These distinctions are based on the consideration that instrumental support also needs to include an emotional and appreciating component (Semmer et al. 2008), and that devaluing support may even be perceived as a stressor (Semmer, Amstad, and Elfering 2006). As the analysis provided in Table 1 shows, all five types of support are observed in the work context, but their prevalence may differ between human and automation-based support.

Support providers have different possibilities for providing support. Support by supervisors (who exert considerable control over working conditions) correlates more strongly with strain than support by colleagues (Mathieu, Eschleman, and Cheng 2019). Family members may be especially important for providing emotional support (Baruch-Feldman et al. 2002). Therefore, different sources of support constitute a second basic aspect of social support (Halbesleben 2006; King et al. 1995; Schwarzer, Knoll, and Rieckmann 2004; Uchino 2004).

Differences in effectiveness may be due to recipients having certain expectations regarding the support provider, which may be related to family roles (McManus and Nussbaum 2011) and professional roles (Semmer et al. 2008). This takes into account provider possibilities (e.g. expertise) and roles (e.g. supervisor, family), and thus includes issues of what can legitimately be expected from a given provider (Cropanzano et al. 2001). Expectations may also differ when the support provider is a machine, as compared to a

Table 1. Main types of support and their relative prevalence in human and automated support; *INS* +: Instrumental support is provided in the form of helpful advice; *INS Ø*: No instrumental support is provided; *EMO* +: Emotional support is provided; *EMO Ø:* No emotional support is provided; *EMO* –: Devaluing support is provided; HS: Human support; ABS: automation-based support.

Type of support	Elements	Description	Example for human support	Example for automated support
Combined valuing support	*INS + EMO +*	A supervisor provides helpful advice and encouragement at the same time. Alternatively, advice and encouragement are provided by self-improvement software and similar applications. This type of support is expected to be more common in HS than in ABS.	Supervisor: 'You'll need to restart the machine. It's a difficult problem, which your fellow operators also found tricky to solve.'	Your Support Centre recommends: Please restart the machine. Your Support Centre informs you: This task is generally very difficult, with our database indicating that 95 % of operators having difficulties with it.
Pure instrumental support	*INS + EMO Ø*	A supervisor provides helpful advice but no encouragement. This is the typical support provided by a decision support system. This type of support is expected to be equally common in HS and in ABS.	Supervisor: 'You'll need to restart the machine.'	Your Support Centre recommends: Please restart the machine.
Devaluing instrumental support	*INS + EMO –*	Supervisor provides helpful advice but, at the same time, criticises recipient for needing it. Since it is rather unlikely that such support is provided by decision support system, it is expected to be much more common in HS than in ABS.	Supervisor: 'You'll need to restart the machine. I'm a bit surprised that you didn't know what to do.'	Your Support Centre recommends: Please restart the machine. Your Support Centre informs you: This task is generally easy to perform, with our database indicating that only 10 % of operators having difficulties with it.
Pure emotional support	*INS Ø EMO +*	Pure emotional support may be provided by fellow operators at work but may be more frequently received from family and friends. In the context of ABS, it may refer to encouragement provided by self-improvement software. This type of support is expected to be more common in HS than in ABS.	Supervisor: 'It's a difficult problem, which your fellow operators also found tricky to solve. You'll soon get the hang of it.'	Your Support Centre informs you: Please note that this task is generally very difficult, with our database indicating that 95 % of operators having difficulties with it. Unfortunately, your Support Centre is unable to give you specific advice of how to solve the problem.
No support	*INS Ø EMO Ø*	This is a typical situation in a non-supportive work environment. This represents a typical situation when no decision support system is available, but humans may also fail to provide support. It is more common in ABS than in HS, though this is expected to change in the future.	Not applicable	Not applicable

human, and even for different types of machines. For example, a personal mobile phone might be perceived more analogous to family and friends with regard to expectations of emotional support than a complex machine that is only used for work purposes.

2.3. Appropriate supportive behaviour

In contrast to the perceived availability of social support, for which positive effects have been consistently found (e.g. Uchino 2004), actual behaviours that are meant to be supportive ('received support') have frequently shown negative effects (Gray et al. 2020; Semmer, Amstad, and Elfering 2006). Evidently, social support (be it human or automated) needs to be 'appropriate' (Semmer et al. in prep.). The most important consideration is that providing social support can potentially threaten the recipient's self-esteem, for instance by making them appear incompetent, weak, or not esteemed (Fisher, Nadler, and Whitcher-Alagna 1982; Semmer et al. 2019). Such effects are likely to occur when imposing support that is not welcome (Deelstra et al. 2003; Gray et al. 2020), when combining support with derogatory remarks (Gray et al. 2020; Semmer, Amstad, and Elfering 2006), or when offering support that does not conform to the situation (e.g. emotional support is offered although the provider could effectively change the situation by providing instrumental support; Cutrona and Russel, 2017) or to the needs of the recipient (e.g. prematurely giving instrumental support where emotional support is needed first; Semmer, Amstad, and Elfering 2006).

In the context of automated support, appropriate support could mean that the 'support centre' asks the operator whether they would like help or avoids providing instrumental advice in a commanding tone, which might cause discomfort and reluctance in the operator. These criteria could be considered an extension of the principles underlying the research on etiquette (e.g. Sheridan and Parasuraman, 2005). To the extent that these criteria are met, social support may be considered 'appropriate' (Semmer et al. in prep.). These criteria could also be helpful for designing automated support.

3. Performance as a key outcome measure

Generally, very few studies examined the effects of social support on performance (e.g. Park, Wilson, and Lee 2004). However, performance-related effects are of particular interest in human factors and ergonomics because of the need to prevent performance degradations in work environments (e.g. in safety-critical systems).

In the present article, we will use an enlarged concept of performance. Concerning task performance, a distinction can be made between primary and secondary performance. In addition, the enlarged performance concept includes aspects outside the core job activities, which has been referred to as organisational citizenship behaviour (e.g. Podsakoff et al. 2000), or extra-role behaviour (e.g. Van Dyne, Cummings, and Parks 1995). The multi-faceted perspective on performance as a global concept is important because the different performance elements may be influenced by social support in different ways.

Extra-role behaviour is increasingly recognised as an important aspect of performance (Sackett and Lievens 2008 Carpini and Parker 2018,). For example, such behaviours are critical for the effective functioning of a work team or a larger organisational unit (e.g. an operator volunteers to help a fellow operator locate a system fault even though it is not part of her job description).

While emotional support may have indirect effects on performance by reducing task-irrelevant cognitions, instrumental support targets performance directly. It may involve tangible help ('giving someone a hand') that improves performance. Furthermore, instrumental support shares elements with training (e.g. when advice is given on how a problem can be solved). There is ample evidence that training and instruction as interventions are rather effective if properly implemented (see meta-analyses by Aguinis and Kraiger 2009; Arthur et al. 2003; Ford, Baldwin, and Prasad 2018). For example, instrumental support may involve pointing out the availability of resources, both human (e.g. who to ask for advice) or material (e.g. which on-line manual to consult for solving the problem). Given the high effectiveness of training and instruction and its conceptual link to instrumental support, performance-enhancing effects are generally expected from the implementation of this form of social support.

Emotional support is expected to have positive effects on performance due to the assumed mechanism that it helps operators cope better with stressful situations. Many stressors induce negative emotions that require additional cognitive capacities during emotional coping. For example, an operator may ruminate about why a fellow operator exhibited such rude behaviour. Such stressful situations would lead to fewer cognitive capacities being available for effective task management, which may consequently impair subsequent performance (Böttcher and Dreisbach, 2014; Elfering, Grebner, and Haller 2012; Weiss and Cropanzano 1996). Emotional support could be effective in reducing such rumination processes and preventing (at least partially) threats to performance by helping restore the operator's subjective operational state (e.g. with regard to self-efficacy and motivation), which in turn supports a focus on task completion.

Based on Hockey (1983), who argues that a range of outcome variables is needed to gain a better understanding of the multiple effects of a stressor ('broadband principle'), we propose four principal performance measures for assessing the impact of social support. Since social support should reduce the negative effects of stress, such a broadband approach appears to be useful in the present context too. The four performance measures presented in Table 2 are particularly suited for experimental studies aiming to capture the effects of social support when adopting the broadband approach. While we focus on performance, other

Table 2. Overview of performance measures referring to different types of tasks.

Outcome measure	Description	Instruments for use in lab-based research
Core task performance		
Primary task performance	Performance on high-priority tasks is an important outcome measure in work context (often protected from decrements due to shifts in resources).	Dynamic simulation of a real work environment
Secondary task performance	Performance on tasks of lower priority is also an important outcome measure in work context, because they may represent a useful measure of workload; it may be especially sensitive because humans often shift their cognitive resources from the secondary to the primary task.	Dynamic simulation of a real work environment
Extra-role performance		
Spontaneous reaction to extra-role requirements	Important outcome measure for organisations, indicating the spontaneous propensity of humans to help fellow employees in need, though this type of help is not part of their job description.	Ten-pencil task (Porath and Erez 2007)
Considered response to extra-role requirements	Similarly, important outcome measure for organisations, though the decision to help is not made spontaneously but after some time of reflection.	Participant feedback questionnaire (Sauer et al. 2023b)

outcome measures are important too (e.g. subjective operator state and psychophysiological state). This broadband approach has the advantage of being able to identify different patterns. For example, positive effects of social support may be limited to increasing extra-role performance but may not emerge in other performance measures. We assume that the principle of reciprocity ('if you've scratched my back, I'll scratch yours') underlies the tendency of support recipients to show increased extra-role performance (Bowling et al. 2004) with the good intent to 'give something back to the support provider or to the organisational community at large'. Since a lack of reciprocity represent an unfavourable working condition (Meier and Semmer 2013), we consider this principle to be important.

Due to the importance we assign to extra-role performance, a distinction between two types of extra-role activities may be promising: spontaneous reactions and considered responses (Sauer et al. 2023a). 'Spontaneous reactions' concern decision-making situations with a short timeframe (e.g. operator interrupts core job activities to help a fellow operator facing a system breakdown), whereas 'considered responses' relate to a longer timeframe (e.g. operator needs to let a fellow operator know by tomorrow whether she is willing to help repair a machine, which is not part of her core job activity). 'Spontaneous reactions' may be expected to be more sensitive to changes in working conditions (e.g. inducing social stress or providing social support) than 'considered responses', with first empirical evidence backing this assumption (Sauer et al. 2023b). Future empirical work could use the performance measures proposed in Table 2 to obtain a more comprehensive assessment of the effects of social support.

4. Automation as a source of social support

4.1. Future role of human and automated support

Over the next few years, important additions to the research literature on social support are expected since the possibilities offered by highly automated systems are intriguing.

Chatbots and large language models are examples of how powerful current forms of automation already are, with the capabilities of these systems set to increase rapidly in the future. Based on these developments, we will first make a coarse comparison between human and automated support, and then propose a multi-level taxonomy in the next section, which outlines several possibilities of how a human and an automated system together can provide support.

Table 3. Expected differences between human and automated support (HS: human support; ABS: automation-based support).

Effects of social support	Probability of effect emerging	Difference between HS and ABS
Increase in extra-role performance	Effect is expected	HS > ABS: More likely to occur for HS than for ABS
Increase in primary core task performance	Weak or no effect is expected	HS = ABS: no difference between the two
Increase in secondary core task performance	Effect is possibly expected	HS = ABS: no difference between the two
Increase in positive affect and decrease in negative affect	Effect is expected	HS > ABS: More likely to occur for HS than for ABS
Increase in self-esteem if support is welcome and a decrease if support is unwelcome	Effect is expected	HS > ABS: More likely to occur for HS than for ABS
Increase in rumination (if support is not welcome)	Effect is possibly expected	HS > ABS: More likely to occur for HS than for ABS

Given that different sources of human social support (from fellow operators, supervisors, family, etc.) have resulted in somewhat different outcomes (e.g. Rook and Ituarte 1999), a similarly differentiated pattern may be expected when different facets of human and automated support are compared. We would make a number of predictions of how different outcome variables would be affected by social support as a function of source (i.e. human versus automation). These predictions refer to the expected differences between human and automated support and to the probability of an effect emerging. They are summarised in Table 3. The following considerations have led us to make these predictions.

Extra-role performance (as the facet of performance that goes beyond core job activities) is expected to be sensitive to support. This is partly based on the principle of reciprocity, that is, an operator may want to return the help received by supporting a colleague with an extra-role activity (Bowling et al. 2004). This impulse might be less pronounced if support was received by the automation. With regard to core task performance, we expect that effects are limited since core tasks are often protected from performance decrements due to the operator concentrating on the primary tasks, for which performance protection is stronger than for secondary tasks (Hockey 1997). Regarding affect and attitudes, social support may induce positive emotions, which are known to foster prosocial behaviour (Algoe, Fredrickson, and Gable 2013; Fredrickson 2000). Furthermore, it may reduce negative reflections about one's work situation (i.e. rumination), which tend to decrease not only well-being but also performance (e.g. by impairing

cognitive functioning; Cropley and Collis 2020). This is in contrast to positive reflections, which may have positive effects on performance-related states such as vigour or dedication (Weigelt, Gierer, and Syrek 2019). Furthermore, receiving a message of appreciation and caring may foster self-esteem (Fisher, Nadler, and Whitcher-Alagna 1982; Semmer et al. 2008, 2019). As the attribution of this appreciative message to a positive intention plays an important role, the effects on affect and attitudes may be less pronounced for automated support than for human support. However, the support provided must be appropriate (i.e. welcoming, appreciative, etc.) in order to have the intended impact.

In general, when comparing human support with automated support, we would expect that human support will produce larger effects (except for core task performance). The reason for expecting stronger reactions to human support compared to automated support is that humans are perceived to be responsible for their action, that is, it is easier to attribute intent to humans than to automation. There is some evidence that humans tend to follow scripts of social interaction when dealing with automation, which includes behaving according to reciprocity principles (i.e. 'supportive' and 'retaliating behaviour') vis-à-vis a computer (Nass and Moon 2000). Such behaviours do not necessarily imply that people really consider the computer as 'human', they may simply be overlearned to such an extent that also are applied to computers. Because of this 'mindless' application (Nass and Moon 2000), we expect such behaviours to occur with automation too, but to be weaker than when dealing with humans.

The research literature examining the role of automated support appears to focus on certain types of technology. A particular promising application area for automated support may be chatbot design. In this area, the role of social support has already been addressed (Beattie and High 2022; Van Wezel, Croes, and Antheunis 2021). A qualitative study on the role of chatbots in providing social support concluded that chatbots can be a good source of social support in everyday situations (Ta et al. 2020). This applies in particular to emotional support and to a lesser extent to instrumental support. Another promising application area is social robotics (e.g. Oliveira et al. 2021). When examining the use of social robotics in care for the elderly, research identified multiple requirements that need to be considered with regard to frail elderly users, ranging from psychological support to completing a set of domestic tasks (García-Soler et al. 2018). Social robots may therefore provide both emotional and instrumental support (e.g. lifting elderly people out of bed). An important question is whether the emotional support provided by human caregivers to the patient could also be provided by a robot (e.g. Erel et al. 2022), and to what extent such automated support would be considered equivalent. While the number of studies in this domain is increasing, some concerns have been raised about their methodological quality in a recent scoping review (Asl et al. 2022). Overall, it suggests that the use of automated support is on the increase (mainly for providing emotional support but also for instrumental support), though it is still somewhat limited to selected application areas.

4.2. Model of automated social support

This leads us to the question of what level of automation is best suited to provide social support under what circumstances. The question surrounding the most appropriate level of automation for a given situation is generally prevalent in automation research in many domains. A number of taxonomies or models have been proposed to provide guidance in that respect, ranging from very comprehensive taxonomies encompassing ten levels (Sheridan and Verplank 1978) to models comprising only five levels (e.g. Endsley and Kiris 1995).

We propose a five-level taxonomy that describes different levels of social support that automation can provide to a human recipient. The taxonomy has a similar structure as the automation taxonomies referred to above (Endsley and Kiris 1995; Sheridan and Verplank 1978), but it is now applied to the context of social support. As shown in Table 4, the taxonomy shows how the activities of the human agent are taken over incrementally by an automated agent. In Sheridan and Verplank's (1978) model, the incremental increase of the involvement of the automated agent refers to the completion of a task, whereas in the present model, it refers to the provision of social support. The model demonstrates that the designer of an automated system has several options of how to conceive the division of labour between a human and an automated agent when providing social support. The taxonomy in Table 4 implicitly acknowledges the existence of two subfactors of social support source: creator (i.e. who conceives the message) and transmitter (i.e. who conveys the message to the recipient). While the importance of this distinction is acknowledged, it is not emphasised within this framework for reasons of simplicity.

The concepts of static versus adaptive, or adaptable automation (e.g. Calhoun 2022; Parasuraman 2000, Tattersall and Hockey 2008; Sauer, Kao, and Wastell

2012) may also be useful when thinking about the best way of designing automation for providing social support. *Static* automation refers to the idea of a certain type of automation being invariably fixed (e.g. the same level of automated support is permanently used). The two other concepts refer to flexible forms of automation, in which either the human operator (adaptable automation) or an automated agent (adaptive automation) decide which level of automation is selected for a given task (e.g. full manual control, intermediate automation level, or full automation). In static automation of social support, the level at which social support is provided is invariably fixed. In *adaptable* automation, a human decides which of the five levels of automated social support is most appropriate under the circumstances (e.g. preference of the recipient, emotional or instrumental content of social support). In *adaptive* automation, this decision is made by the automated system. Using flexible forms of automated social support is expected to aid designers in tailoring the support to the need of the recipient. For example, for a support message with predominantly emotional content a lower level of automation may be chosen than for a support message of a largely instrumental nature. Of particular interest are levels 3 to 5 in the taxonomy presented in Table 4 because they involve a substantial input of the automation in the process of giving social support.

Some connections between concepts used in the automation and social support literatures could be of interest given that the two research literatures are rather separate. As a first concept, 'adaptable automation' (e.g. Parasuraman 2000) shares elements with recipient-initiated social support because it is the human operator who decides on the level of support (by increasing the automation level or by requesting social support from a human or automation, respectively). As a second concept, 'adaptive automation' (e.g. Parasuraman 2000) has similarities with provider-initiated social support because in both cases the human operator does not decide whether support is provided. In adaptive automation, the receiving human operator (who is in a passive position) depends on the automated system to provide (increasing) assistance. If there is provider-initiated support, the recipient of social support (who is in a passive position too) depends on the automated system or a human provider to offer support.

The distinction between support that is initiated by the provider and support that is initiated by the recipient (Alder 2007) is important in many respects. Asking for support has the advantage of avoiding the provision of unwanted support. At the same time, it may result in increased workload because of operators having to decide whether to change the automation level in addition to normal task activities (Prinzel and Kaber 2006). Therefore, operators may not make adequate use of this facility under high workload. Furthermore, asking for support implies 'social costs', such as the risk of appearing incompetent (Fisher, Nadler, and Whitcher-Alagna 1982). We hypothesise that these concerns about threat to self-esteem will be lower for automated systems compared to humans, as the automation is less likely to be perceived as judging the recipient in an unfavourable way (e.g. as lacking competence or as having wasted computing time when dealing with the request of the recipient). However, it is important to consider that recipients may worry that their help-seeking behaviour is recorded and may be negatively evaluated by fellow operators or supervisors.

As a third concept, 'etiquette' (Sheridan and Parasuraman, 2005; Parasuraman and Miller 2004) may be considered as 'neutral, or minimal, emotional support' in the sense of an absence of devaluing messages that are described in Table 1. The concept of

Table 4. Taxonomy of different levels of social support offered by automation.

Automation level	Type of social support	Description	Example
1	Full and exclusive support given by human	Human support is directly transmitted to fellow operator without the aid of technical means	Fellow operator makes helpful suggestions on site of how to deal with a breakdown of a production system
2	Human support transmitted with aid of automation	Human support is being transmitted by means of a computer-based aid (e.g. videoconference system, written message)	Fellow operator makes helpful suggestions by means of a video link of how to deal with a breakdown of a production system
3	Hybrid support involving humans and automation	Human support is being transmitted by means of a computer-based aid, with the automation adding further content to the content created by the human	Automation supports operator with encouragement and helpful advice by indicating that these support messages partly originate from machine learning and partly from experienced fellow operators who are familiar with such problems
4	Automated support complemented by human	Automated support is being transmitted, with the human adding further content to the content created by the automation	Automation supports operator with encouragement and helpful advice by indicating that the support messages mainly originate from machine learning but experienced fellow operators have added to the content
5	Fully automated support	Automation provides fully automated support with no human involvement	Automation makes helpful suggestions to operator of how to deal with a system breakdown (including some encouragement being provided)

etiquette refers to the appropriateness of automation-human communication in terms of the automation adhering to prevailing communication rules. For example, the automation should not interrupt the human, should not give undesired advice, and should not pressurise the human into taking action. These observations related to etiquette are important since they suggest that a similar form of interaction may be required when automation provides social support. However, following the rule of etiquette does not already constitute social support. A fourth possibility is emerging with the development of artificial intelligence that involves going beyond formal requirements (Bowling et al. 2004) by 'going the extra mile' to support a fellow operator, which is an important element of social support (Lam, Wan, and Roussin 2016). Therefore, decision support systems (Liu et al. 2010) may learn to communicate compassion and encouragement, and thus offer an optimised combination of instrumental and emotional support (Semmer et al. 2008).

5. Outlook and conclusion

There may be some ethical concern that the automation may exhibit manipulative behaviour towards the operator. There is no simple answer where to draw the line, and further research will have to deal with this issue. One may also ask in a more fundamental way whether automation is actually able to provide 'support', as supportive behaviour implies an intention to help. While this cannot be denied, we feel there is some evidence showing that humans employ scripts of social behaviour even when dealing with automated systems, although they acknowledge their non-human nature (Nass and Moon 2000). This tendency is well illustrated by the importance of 'etiquette' (Sheridan and Parasuraman 2005). We do not assume that automation will be able to provide support to the same extent as humans can, but based on the social scripts previously mentioned, it seems that automation can provide social support to some degree, and it is worth examining its possibilities as well as its limits. In doing so, research and practice will have to address ethical issues arising from an automated system being programmed such that it 'pretends' to care about the operator by providing instrumental and notably emotional support. Therefore, transparency should be an issue in all these developments.

The considerations and the research literature presented in this article suggest that the concept of social support could play an important role in the domain of human-automation interaction. If social support proved to be effective in increasing certain facets of performance, automated social support could represent a primary intervention in the design of technical systems. With regard to the role of automated social support for increasing human well-being, it seems that the important supportive role that humans play at work as support providers may be adopted by an automated agent to some extent. This is of particular importance since the number of human colleagues (i.e. the number of potential sources of human support) is likely to decrease in the future due to automation. However, we would like to reiterate that the propositions and taxonomies presented in this article still need to undergo empirical testing to assess their validity. This requires a series of studies, employing a range of different methods, including interviews with operators in the field, vignette studies entailing simulations of design options but also experimental work examining these design options in high-fidelity scenarios. Since the design of automated social support is associated with intricacies, the importance of empirical testing the design options needs to be reiterated. Once such empirical data is available, more precise recommendations can be made for the design of automated social support.

Based on these considerations, we are confident that the field of automated social support will further gain in importance in the future. The present article may help initiate some debate about how we can better integrate the concepts and approaches used in the different scientific communities in the interdisciplinary field of designing automation

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethical statement

This is a theoretical paper, which did not involve the testing of human participants. Therefore, no approval from the ethics committee was required.

Funding

This work was supported by the Swiss National Science Foundation under grant number 173344.

ORCID

Juergen Sauer http://orcid.org/0000-0003-2105-1694

References

Aguinis, H., and K. Kraiger. 2009. "Benefits of Training and Development for Individuals and Teams, Organizations, and Society." *Annual Review of Psychology* 60 (1): 451–474. doi:10.1146/annurev.psych.60.110707.163505.

Alder, G. S. 2007. "Examining the Relationship between Feedback and Performance in a Monitored Environment: A Clarification and Extension of Feedback Intervention Theory." *The Journal of High Technology Management Research* 17 (2): 157–174. doi:10.1016/j.hitech.2006.11.004.

Algoe, S. B., B. L. Fredrickson, and S. L. Gable. 2013. "The Social Functions of the Emotion of Gratitude via Expression." *Emotion (Washington, D.C.)* 13 (4): 605–609. doi:10.1037/a0032701.

Allen, V. L., and J.M. Levine. 1968. "Social Support, Dissent and Conformity." *Sociometry* 31 (2): 138–149. doi:10.2307/2786454.

Arthur, W., W. Bennett, Jr., P. S. Edens, Jr., and S. T. Bell. 2003. "Effectiveness of Training in Organizations: A Meta-Analysis of Design and Evaluation Features." *The Journal of Applied Psychology* 88 (2): 234–245. doi:10.1037/0021-9010.88.2.234.

Asl, A. M., M. M. Ulate, M. F. Martin, and H. van der Roest. 2022. "Methodologies Used to Study the Feasibility, Usability, Efficacy, and Effectiveness of Social Robots for Elderly Adults: scoping Review." *Journal of Medical Internet Research* 24 (8): e37434. doi:10.2196/37434.

Barling, J., K. E. MacEwen, and L. I. Pratt. 1988. "Manipulating the Type and Source of Social Support: An Experimental Investigation." *Canadian Journal of Behavioural Science / Revue Canadienne Des Sciences du Comportement* 20 (2): 140–153. doi:10.1037/h0079923.

Barrera, M.Jr. 2000. "Social Support Research in Community Psychology." In *Handbook of Community Psychology*, edited by Rappaport, J. and Seidman E., 215–245. Springer, Boston: Kluwer Academic Publishers. doi:10.1007/978-1-4615-4193-6_10.

Barrera, M., Jr,., and S. L. Ainlay. 1983. "The Structure of Social Support: A Conceptual and Empirical Analysis." *Journal of Community Psychology* 11 (2): 133–143. doi:10.1002/1520-6629(198304)11:2<133::aid-jcop2290110207>3.0.co;2-l.

Baruch-Feldman, C., E. Brondolo, D. Ben-Dayan, and J. Schwartz. 2002. "Sources of Social Support and Burnout, Job Satisfaction, and Productivity." *Journal of Occupational Health Psychology* 7 (1): 84–93. doi:10.1037/1076-8998.7.1.84.

Beattie, A. J., and A. C. High. 2022. "I Get by with a Little Help from my Bots: Implications of Machine Agents in the Context of Social Support." *Human-Machine Communication* 4: 151–168. doi:10.30658/hmc.4.8.

Böttcher, S., and G. Dreisbach. 2014. "Socially Triggered Negative Affect Impairs Performance in Simple Cognitive Tasks." *Psychological Research* 78 (2): 151–165. doi:10.1007/s00426-013-0488-6.

Bowling, N.A., T. A. Beehr, A. L. Johnson, N. K. Semmer, E. A. Hendricks, and H. A. Webster. 2004. "Explaining Potential Antecedents of Workplace Social Support: Reciprocity or Attractiveness?" *Journal of Occupational Health Psychology* 9 (4): 339–350. doi:10.1037/1076-8998.9.4.339.

Broadwell, P., N. Davis, and S. Yoon. 2022. "Using Artificial Intelligence to Develop a Lexicon-Based African American Tweet Detection Algorithm to Inform Culturally Sensitive Twitter-Based Social Support Interventions for African American Dementia Caregivers." *Studies in Health Technology and Informatics* 289: 1–4. doi:10.3233/SHTI210844.

Calhoun, G. 2022. "Adaptable (Not Adaptive) Automation: Forefront of Human – Automation Teaming." *Human Factors* 64 (2): 269–277. doi:10.1177/00187208211037457.

Carpini, J. A., and S. K. Parker. 2018. "The Bigger Picture: How Organizational Citizenship Behaviors Fit within a Broader Conceptualization of Work Performance." In *The Oxford Handbook of Organizational Citizenship Behavior*, edited by P. M. Podsakoff, S. B. MacKenzie, & N. P. Podsakoff, 19–42. Oxford: Oxford University Press.

Cobb, S. 1976. "Social Support as a Moderator of Life Stress." *Psychosomatic Medicine* 38 (5): 300–314. doi:10.1097/00006842-197609000-00003.

Cropanzano, R., Z. S. Byrne, D. R. Bobocel, and D. E. Rupp. 2001. "Moral Virtues, Fairness Heuristics, Social Entities, and Other Denizens of Organizational Justice." *Journal of Vocational Behavior* 58 (2): 164–209. doi:10.1006/jvbe.2001.1791.

Cropley, M., and H. Collis. 2020. "The Association between Work-Related Rumination and Executive Function Using the Behavior Rating Inventory of Executive Function." *Frontiers in Psychology* 11: 821. doi:10.3389/fpsyg.2020.00821.

Cutrona, C. E., and D. W. Russell. 2017. "Autonomy Promotion, Responsiveness, and Emotion Regulation Promote Effective Social Support in Times of Stress." *Current Opinion in Psychology* 13: 126–130. doi:10.1016/j.copsyc.2016.07.002.

Cutrona, C. E., and J. A. Suhr. 1992. "Controllability of Stressful Events and Satisfaction with Spouse Support Behaviors." *Communication Research* 19 (2): 154–174. doi:10.1177/009365092019002002.

Deelstra, J. T., M. C. Peeters, W. B. Schaufeli, W. Stroebe, F. R. Zijlstra, and L. P. van Doornen. 2003. "Receiving Instrumental Support at Work: when Help is Not Welcome." *The Journal of Applied Psychology* 88 (2): 324–331. doi:10.1037/0021-9010.88.2.324.

Elfering, A., S. Grebner, and M. Haller. 2012. "Railway-Controller-Perceived Mental Workload, Cognitive Failure and Risky Commuting." *Ergonomics* 55 (12): 1463–1475. doi:10.1080/00140139.2012.718802.

Endsley, M. R., and E. O. Kiris. 1995. "The Out-Of-The-Loop Performance Problem and Level of Control in Automation." *Human Factors: The Journal of the Human Factors and Ergonomics Society* 37 (2): 381–394. doi:10.1518/001872095779064555.

Erel, H., D. Trayman, C. Levy, A. Manor, M. Mikulincer, and O. Zuckerman. 2022. "Enhancing Emotional Support: The Effect of a Robotic Object on Human–Human Support Quality." *International Journal of Social Robotics* 14 (1): 257–276. doi:10.1007/s12369-021-00779-5.

Fisher, J. D., A. Nadler, and S. Whitcher-Alagna. 1982. "Recipient Reactions to Aid." *Psychological Bulletin* 91 (1): 27–54. doi:10.1037/0033-2909.91.1.27.

Ford, J. K., T. T. Baldwin, and J. Prasad. 2018. "Transfer of Training: The Known and the Unknown." *Annual Review of Organizational Psychology and Organizational Behavior* 5 (1): 201–225. doi:10.1146/annurev-orgpsych-032117-104443.

Fredrickson, B. L. 2000. "Why Positive Emotions Matter in Organizations: Lessons from the Broaden-and-Build Model."

The Psychologist-Manager Journal 4 (2): 131–142. doi:10.1037/h0095887.

French, K. A., S. Dumani, T. D. Allen, and K. M. Shockley. 2018. "A Meta-Analysis of Work–Family Conflict and Social Support." *Psychological Bulletin* 144 (3): 284–314. doi:10.1037/bul0000120.

García-Soler, Á., D. Facal, U. Díaz-Orueta, L. Pigini, L. Blasi, and R. Qiu. 2018. "Inclusion of Service Robots in the Daily Lives of Frail Older Users: A Step-by-Step Definition Procedure on Users' Requirements." *Archives of Gerontology and Geriatrics* 74: 191–196. doi:10.1016/j.archger.2017.10.024.

Gerhardt, Christin, Norbert K. Semmer, Sabine Sauter, Alexandra Walker, Nathal de Wijn, Wolfgang Kälin, Maria U. Kottwitz, Bernd Kersten, Benjamin Ulrich, and Achim Elfering. 2021. "How Are Social Stressors at Work Related to Well-Being and Health? A Systematic Review and Meta-Analysis." *BMC Public Health* 21 (1): 890. doi:10.1186/s12889-021-10894-7.

Gray, C. E., P. E. Spector, K. N. Lacey, B. G. Young, S. T. Jacobsen, and M. R. Taylor. 2020. "Helping May be Harming: Unintended Negative Consequences of Providing Social Support." *Work and Stress* 34 (4): 359–385. doi:10.1080/02678373.2019.1695294.

Halbesleben, J. R. 2006. "Sources of Social Support and Burnout: A Meta-Analytic Test of the Conservation of Resources Model." *The Journal of Applied Psychology* 91 (5): 1134–1145. doi:10.1037/0021-9010.91.5.1134.

Hockey, G. R. J. 1983. *Human Performance: Stress and Fatigue in Humans*. Wiley: Chichester.

Hockey, G. R. J. 1997. "Compensatory Control in the Regulation of Human Performance under Stress and High Workload: A Cognitive-Energetical Framework." *Biological Psychology* 45: 73–93. doi:10.1016/S0301-0511(96)05223-4.

Holt-Lunstad, J., and B. N. Uchino. 2015. "Social Support and Health." In *Health Behavior: Theory, Research and Practice*, edited by K. Glanz, B. K. Rimer & K. Viswanath, 183–204. New York, NY: Jossey-Bass/Wiley.

House, J. S., D. Umberson, and K. R. Landis. 1988. "Structures and Processes of Social Support." *Annual Review of Sociology* 14 (1): 293–318. doi:10.1146/annurev.so.14.080188.001453.

King, L. A., L. K. Mattimore, D. W. King, and G. A. Adams. 1995. "Family Support Inventory for Workers: A New Measure of Perceived Social Support from Family Members." *Journal of Organizational Behavior* 16 (3): 235–258. doi:10.1002/job.4030160306.

Kossek, E. E., S. Pichler, T. Bodner, and L. B. Hammer. 2011. "Workplace Social Support and Work–Family Conflict: A Meta-Analysis Clarifying the Influence of General and Work–Family-Specific Supervisor and Organizational Support." *Personnel Psychology* 64 (2): 289–313. doi:10.1111/j.1744-6570.2011.01211.x.

Lam, C. F., W. H. Wan, and C. J. Roussin. 2016. "Going the Extra Mile and Feeling Energized: An Enrichment Perspective of Organizational Citizenship Behaviors." *The Journal of Applied Psychology* 101 (3): 379–391. doi:10.1037/apl0000071.

Liu, S., A. H. Duffy, R. I. Whitfield, and I. M. Boyle. 2010. "Integration of Decision Support Systems to Improve Decision Support Performance." *Knowledge and Information Systems* 22 (3): 261–286. doi:10.1007/s10115-009-0192-4.

Mathieu, M., K. J. Eschleman, and D. Cheng. 2019. "Meta-Analytic and Multiwave Comparison of Emotional Support and Instrumental Support in the Workplace." *Journal of Occupational Health Psychology* 24 (3): 387–409. doi:10.1037/ocp0000135.

Matthews, G., D. R. Davies, R. B. Stammers, and S. J. Westerman. 2000. *Human Performance: Cognition, Stress, and Individual Differences*. Hove, UK: Psychology Press. doi:10.1177/106480460100900211.

McManus, T. G., and J. F. Nussbaum. 2011. "Social Support Expectations and Strategic Ambiguity in Parent–Young Adult Child Divorce-Related Stressor Conversations." *Journal of Divorce & Remarriage* 52 (4): 244–270. doi:10.1080/10502556.2011.585083.

Meier, L. L., and N. K. Semmer. 2013. "Lack of Reciprocity, Narcissism, Anger, and Instigated Workplace Incivility: A Moderated Mediation Model." *European Journal of Work and Organizational Psychology* 22 (4): 461–475. doi:10.1080/1359432X.2012.654605.

Morelli, S. A., I. A. Lee, M. E. Arnn, and J. Zaki. 2015. "Emotional and Instrumental Support Provision Interact to Predict Well-Being." *Emotion (Washington, D.C.)* 15 (4): 484–493. doi:10.1037/emo0000084.

Nass, C., and Y. Moon. 2000. "Machines and Mindlessness: social Responses to Computers." *Journal of Social Issues* 56 (1): 81–103. doi:10.1111/0022-4537.00153.

Oliveira, R., P. Arriaga, F. P. Santos, S. Mascarenhas, and A. Paiva. 2021. "Towards Prosocial Design: A Scoping Review of the Use of Robots and Virtual Agents to Trigger Prosocial Behaviour." *Computers in Human Behavior* 114: 106547. doi:10.1016/j.chb.2020.106547.

Parasuraman, R. 2000. "Designing Automation for Human Use: empirical Studies and Quantitative Models." *Ergonomics* 43 (7): 931–951. doi:10.1080/001401300409125.

Parasuraman, R., and C. A. Miller. 2004. "Trust and Etiquette in High-Criticality Automated Systems." *Communications of the ACM* 47 (4): 51–55. doi:10.1145/975817.975844.

Park, K. O., M. G. Wilson, and M. S. Lee. 2004. "Effects of Social Support at Work on Depression and Organizational Productivity." *American Journal of Health Behavior* 28 (5): 444–455. doi:10.5993/ajhb.28.5.7.

Podsakoff, P. M., S. B. MacKenzie, J. B. Paine, and D. G. Bachrach. 2000. "Organizational Citizenship Behaviors: A Critical Review of the Theoretical and Empirical Literature and Suggestions for Future Research." *Journal of Management* 26 (3): 513–563. doi:10.1177/014920630002600307.

Porath, C. L., and A. Erez. 2007. "Does Rudeness Really Matter? The Effects of Rudeness on Task Performance and Helpfulness." *Academy of Management Journal* 50 (5): 1181–1197. doi:10.5465/amj.2007.20159919.

Prinzel, III., L. J, and D. B. Kaber. 2006. "Adaptive and Adaptable Automation Design: A Critical Review of the Literature and Recommendations for Future Research." NASA report.

Rook, K. S., and P. H. Ituarte. 1999. "Social Control, Social Support, and Companionship in Older Adults' Family Relationships and Friendships." *Personal Relationships* 6 (2): 199–211. doi:10.1111/j.1475-6811.1999.tb00187.x.

Sackett, P. R., and F. Lievens. 2008. "Personnel Selection." *Annual Review of Psychology* 59 (1): 419–450. doi:10.1146/annurev.psych.59.103006.093716.

Sage, A., C. Roberts, L. Geryk, B. Sleath, D. Tate, and D. Carpenter. 2017. "A Self-Regulation Theory–Based Asthma Management Mobile App for Adolescents: A Usability Assessment." *JMIR Human Factors* 4 (1): e7133. doi:10.2196/humanfactors.7133.

Sauer, J., C. Centner, S. Longhi, C. Siggen, and L. Tettamanti. 2023b. "Social Stress, Performance after-Effects and Extra-Role Behaviour." *Ergonomics* 66 (1): 88–100. doi:10.1080/00140139.2022.2059575.

Sauer, J., C. S. Kao, and D. Wastell. 2012. "A Comparison of Adaptive and Adaptable Automation under Different Levels of Environmental Stress." *Ergonomics* 55 (8): 840–853. doi:10.1080/00140139.2012.676673.

Sauer, J., S. Schmutz, A. Sonderegger, and N. Messerli. 2019. "Social Stress and Performance in Human-Machine Interaction: A Neglected Research Field." *Ergonomics* 62 (11): 1377–1391. doi:10.1080/00140139.2019.1652353.

Sauer, J., A. Sonderegger, S. Thuillard, and N. K. Semmer. 2023a. "Social Stress in Human-Machine Systems: opportunities and Challenges of an Experimental Research Approach." *Theoretical Issues in Ergonomics Science* 24 (1): 29–53. doi:10.1080/1463922X.2022.2040062.

Schneider, S., M. Goerlich, and F. Kummert. 2017. "A Framework for Designing Socially Assistive Robot Interactions." *Cognitive Systems Research* 43: 301–312. doi:10.1016/j.cogsys.2016.09.008.

Schwarzer, R., N. Knoll, and N. Rieckmann. 2004. " "*Social Support*." In *Health Psychology*, edited by A. Kaptein & J. Weinman, 158–182. Oxford: Blackwell.

Semmer, N. K., A. Elfering, N. Jacobshagen, T. Perrot, T. A. Beehr, and N. Boos. 2008. "The Emotional Meaning of Instrumental Social Support." *International Journal of Stress Management* 15 (3): 235–251. doi:10.1037/1072-5245.15.3.235".

Semmer, N. K., A. Sonderegger, and J. Sauer. in prep. "The Concept of Appropriateness in the Design of Social Support.". Unpublished manuscript."

Semmer, N. K., F. Tschan, N. Jacobshagen, T. A. Beehr, A. Elfering, W. Kälin, and L. L. Meier. 2019. "Stress as Offense to Self: A Promising Approach Comes of Age." *Occupational Health Science* 3 (3): 205–238. doi:10.1007/s41542-019-00041-5.

Semmer, N. K., F. Amstad, and A. Elfering. 2006. "Dysfunctional Social Support." Paper Presented at the 6th International Conference on Occupational Stress and Health, Miami, FL.

Shakespeare-Finch, J., and P. L. Obst. 2011. "The Development of the 2-Way Social Support Scale: A Measure of Giving and Receiving Emotional and Instrumental Support." *Journal of Personality Assessment* 93 (5): 483–490. doi:10.1080/00223891.2011.594124.

Sheridan, T. B., and R. Parasuraman. 2005. "Human-Automation Interaction." *Reviews of Human Factors and Ergonomics* 1 (1): 89–129. doi:10.1518/155723405783703.

Sheridan, T. B., and W. L. Verplank. 1978. "*Human and Computer Control of Undersea Teleoperators*." *Massachusetts Inst of Tech Cambridge Man-Machine Systems Lab*.

Sonnentag, S., and M. Frese. 2013. *Stress in Organizations*. Chichester: John Wiley & Sons, Inc. doi:10.1002/9781118133880.hop212021.

Ta, Vivian, Caroline Griffith, Carolynn Boatfield, Xinyu Wang, Maria Civitello, Haley Bader, Esther DeCero, and Alexia Loggarakis. 2020. "User Experiences of Social Support from Companion Chatbots in Everyday Contexts: thematic Analysis." *Journal of Medical Internet Research* 22 (3): e16235. doi:10.2196/16235.

Tattersall, A. J., and G. R. J. Hockey. 2008. "Demanding Work, Technology, and Human Performance." In *Introduction to Work and Organizational Psychology: A European Perspective*, edited by N. Chmielm, 169–189. Malden, MA: Blackwell.

Uchino, B. N. 2004. *Social Support and Physical Health: Understanding the Health Consequences of Relationships*. London: Yale University Press. doi:10.12987/yale/9780300102185.001.0001.

Van Dyne, L., L. L. Cummings, and J. M. Parks. 1995. "Extra Role Behaviors: In Pursuit of Construct and Definitional Clarity." In *Research in Organizational Behavior*, edited by L.L. Curamings, and B.M. Staw, 215–285. Greenwich: JAI Press.

Van Wezel, M. M., E. A. Croes, and M. L. Antheunis. 2021. ""I'm Here for You": Can Social Chatbots Truly Support Their Users?" A Literature Review. In *Chatbot Research and Design: 4th International Workshop, CONVERSATIONS 2020, Virtual Event, November 23–24, 2020, Revised Selected Papers 4* 96-113. Springer International Publishing.

Viswesvaran, C., J. I. Sanchez, and J. Fisher. 1999. "The Role of Social Support in the Process of Work Stress: A Meta-Analysis." *Journal of Vocational Behavior* 54 (2): 314–334. doi:10.1006/jvbe.1998.1661.

Weigelt, O., P. Gierer, and C. J. Syrek. 2019. "My Mind is Working Overtime—towards an Integrative Perspective of Psychological Detachment, Work-Related Rumination, and Work Reflection." *International Journal of Environmental Research and Public Health 16* (16): 2987. doi:10.3390/ijerph16162987.

Weiss, H. M., and R. Cropanzano. 1996. "Affective Events Theory." *Research in Organizational Behavior* 18 (1): 1–74.

Woods, V. 2005. "Work-Related Musculoskeletal Health and Social Support." *Occupational Medicine (Oxford, England)* 55 (3): 177–189. doi:10.1093/occmed/kqi085.