

## Old is Gold: Integrating Older Workers in CSCW

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### Abstract

*The tradition of a worker who retires by age 65 is being replaced by a trend of longer periods of employment, leading people to believe that an aging workforce will be a major social transformation of this century. With the proliferation of collaborative tools in workplace settings, we posit that it is essential to address the unique characteristics of older workers when designing groupware. In this paper, we marshal literature from adult learning, training, and work to articulate the unique assets and competencies of older workers, notably: knowledge and experience, adeptness in social group dynamics, and finely tuned strategies for improving group performance and productivity grounded in prior experiences. Further, we argue that the CSCW community should leverage these opportunities to support the expanding older workforce with groupware. We describe a synthetic approach to study how we might best support older workers in workplace settings and outline design implications for CSCW.*

### 1. Introduction

*“Bill is 73, but his dad won’t let him retire. Charlotte is 97 and her big sister still wants to tell her what to do. Natalie has been trying to please her mother since the Hoover administration.”* [18]

In this New York Times Magazine article, Bill’s dad, Reuben, a centenarian and founder of the law firm Landau & Landau, still expects his son to keep the family business alive. This is staggering, gerontologically speaking and otherwise! At Bill’s age, one presumably visualizes sitting comfortably in a rocking chair and telling family stories to grandkids or even great-grandkids. With older workers reentering or staying in the workforce, we should ask ourselves if existing technology is prepared to support this new cohort. As CSCW researchers, a more specific question concerns how CSCW design should accommodate this older workforce.

Most research on older workers has sought to compensate for age-related deficits like cognitive, perceptual, and motor declines. Even the limited research in HCI has focused on ameliorating the deficiencies of old age, for example, by improving usability of existing

technologies (see [16, 38, 44]; ACM Conference on Universal Usability). Clearly, ameliorative approaches are important and much needed. However, we also call for research oriented toward *capitalizing* on the knowledge, skills, and other assets that older workers possess. Older workers hold unique resources from previous work and life experiences—a wealth of knowledge and domain expertise, highly refined social skills, and problem-solving insights into anomalous work situations. Prior experience and practice of older workers can compensate for their age-related declines [15].

The design of CSCW systems for older workers is contingent upon an in-depth analysis of the problem domain. Without sound design rationale and theoretical grounding, supporting older workers in CSCW will be a vicious circle by building groupware, albeit usable, for the wrong requirements.

In this paper, we heuristically identify relevant literature in areas of collaborative work, adult learning and training, and organizational studies to arrive at design implications for supporting older workers. We describe a synthetic approach to analyze the problem, and we use scenarios [10] as an evocative technique to assimilate, analyze, and translate relevant issues from the selected literature toward CSCW design.

### 2. Background and motivation

The following arguments motivate our investigation. *Overall population is aging at a fast rate and life expectancy is increasing.* By the year 2030, 20% of the US population will be 65 or older [16]. *Simultaneously, the overall workforce age is aging, with older workers staying in or reentering the workforce.* Older workers are embarking on a third stage of working life—the period beyond traditional retirement and final disengagement from the work role [47]. *Moreover, older workers tend to work in jobs that are more cognitively demanding and less physically demanding* [27].

*CSCW and groupware have become commonplace in workplace settings.* This trend, coupled with globally competitive pressures and rapid technological advances, are forcing workers in general to adapt to changing organizational requirements [9]. Increasingly, work and learning are becoming equivalent [54]. Given that older workers are an increasing component of a workplace where

CSCW technologies have become the norm, there is an urgent need to consider the implications of this trend for CSCW as a field and as a science of design.

In this paper, we do not limit our definition of older workers because of its inconsistency in existing literature. Generally, the term older worker extends from 40 to 75 years of age [47]. However, individuals are sometimes categorized as “older workers” on the basis of their status as midlife career changers, retirees returning to the labor force, displaced/dislocated workers, or displaced homemakers [39]. Perhaps becoming an older worker is more situational than chronological [47].

Our paper is a call to the CSCW community to acknowledge, at the very least, and hopefully launch an appropriate effort to study older workers in context of collaborative work. Baby boomers have already arrived and they are here to stay. We have taken the onus of considering this gap as an opportunity for CSCW researchers.

Like all designers, we wish we could pull out design guidelines out of a hat and take a satisfying bow in front of an enchanting crowd. Alas, we are dealing with a complex, multi-dimensional problem that requires careful articulation without any shortcuts and fancy tricks. Following is our contribution in this paper:

- Analysis of literature on older workers
- Identification of opportunities for older workers
- First-level approximation of a theoretical framework to study older workers in CSCW
- Design implications for groupware
- Design tradeoffs that designers should consider

### 3. Challenges and opportunities

Mel Reigsecker, a veteran interviewer and founder of Reigsecker Marketplace Inc., says “Part of what keeps this \$13 million business successful is hiring people over age 50.” During interviews, he is turned off by the sometimes arrogant attitude of recent graduates versus the experience, skill and solid work ethics of the mature worker. Reigsecker also notes that his 27-year old son, Ryan, was mentored by and worked closely with a 60-year old worker who once managed the \$894 million sales of a large corporation. Says Reigsecker: “They made a tremendous team.” [56]

The above excerpt is just one example among many that illustrates the opportunities that older workers provide in workplace settings. Older workers do bring age-related challenges with them, but many worries about such problems are misguided assumptions and stereotypes—for example the myths that depict older workers as physically unable, less productive, less motivated, and less able to learn than younger workers [29]. To capitalize on the assets of older workers, we first must understand both the opportunities and the challenges that they bring in terms of, respectively, valuable resources (e.g. domain knowledge) and special needs (e.g.

paced work rhythms). Consider this “Cross-generational collaboration” scenario:

*Bernard, a senior accountant with 30+ years of experience in his field, was recently laid off from Berkshire Auditing during a downsizing because of his poor computer skills. Highly motivated to learn technological skills, he accepts a lower position with H&M Block to avail an opportunity for learning the use of the latest computer auditing tools for eight weeks as part of job training orientation. Bernard is paired up with Lucy, a young and newly hired tax clerk who has an associate degree in accounting with multiple certifications in using tax auditing software. Lucy illustrates the use of the AutoAccount software that automatically scans all tax forms and sorts them according to tax return amount and standard itemized deductions. Bernard immediately acknowledges the efficiency of AutoAccount and keeps track of each step that Lucy explains in his notebook.*

*After a couple of weeks Bernard is familiar with AutoAccount, and he happens to note that the software doesn't account for leased car deductions for small businesses, which would place them in a completely different tax bracket. He suggests printing hard copies of all tax forms and manually categorizing them according to these anomalies. But Lucy only knows how to audit with AutoAccount, so is used to handling anomalies at the end of the process. She brushes off Bernard's suggestion, arguing that working by hand through the pile of tax forms stacked on her desk will be inefficient.*

*Bernard is taken aback by Lucy's slighting remarks and attempts to convince her by printing a hardcopy and demonstrating the benefits of intercepting the leased car deductions early on in the process. He suggests that she is only interested in following a program and not in processing tax returns. Lucy, in her defense, cites her “employee of the month” award for processing the most tax forms last month. Bernard is impressed by this, and relates an experience he had in his old company to Lucy, an episode in which he won a bonus for performance but later learned that he had been using an inefficient method. During their discussion, Lucy suddenly recalls from her training classes that it is possible to annotate the tax forms directly on the soft copy. Although this feature was meant for copy editing, Lucy creatively adopts the feature to capture and track the anomalies.*

In this scenario, Bernard exchanges senior status in a job for an opportunity to learn new skills. Bernard and Lucy leverage each other's expertise. His experience leads him to be sensitive to exceptions and to value long-term efficiency, whereas Lucy's view of performance is quantity-driven. Both have mutual biases about one other. The whole scenario exemplifies many of the challenges and opportunities of older workers.

Bernard's out-of-date skills exemplify a common situation older workers face due to rapid technological change. Issues of skill obsolescence and worker retraining are highly significant for older workers, as they are less

likely than younger workers to have had exposure to technology [15]. Further, there are mistaken beliefs that older workers lack interest in new technologies, often causing them to be bypassed for training or retraining opportunities [15, 44]. Management studies have documented the attitudes that limit job options and training opportunities of older workers [43]. In contradiction to these workplace attitudes, older adults do want to learn about new technologies [44] and are quite capable of learning new skills, tasks, and procedures [15].

Traditional training methods such as lectures are less effective for older learners than group discussions and problem solving [31]. Bernard is paired with Lucy as part of learning new technological skills. This pairing can be seen as mutual “cognitive apprenticeship” [14] where meaningful and bidirectional learning is taking place in context of authentic work. In some situations, mixed-age groups perform better than homogeneous groups [51]. Apprenticeship in such groups is less likely to be unidirectional—while Bernard is learning from Lucy about technology and new work practices, there is also a transfer of domain knowledge, skill, and experience, implicitly or explicitly, from Bernard to Lucy. Bernard and Lucy have higher levels of competence in different knowledge domains, skill sets, and experiences, and therefore, a process of osmosis is created during apprenticeship in context of their own “zone of proximal development” [58]. We reflect more on the effects of mixed age groups in following paragraphs.

Older workers respond well to information about the potential benefits associated with using technology [15]. Motivation to use technology is generally dependent on realizing its benefit; Stein and Rocco [47] have proposed “motivation” and “familiarity” as part of criteria for effectively training older workers. In our scenario, Bernard self-consciously acknowledges the benefit of technology; this in turn motivates him to take notes for later recall and reflection, much as he has learned in the past by taking notes in courses [45].

The personal job experience of older workers provides special benefits for their team such as their recognition of and sensitive reactions to irregularities in operating procedures [51]. Identifying exceptions, such as a tax anomaly by Bernard, is often a matter of intuition based on tacit knowledge [55]. This is a form of experience-based knowledge that is acquired through practice rather than systematic learning. It builds up in a tacit manner and requires considerable time (practice) to be useful as practical, action-oriented knowledge [51].

Psychologists have suggested that tacit knowledge has a procedural nature—it is “knowing how” rather than “knowing that” [49]. Because Lucy has little or no experience, she is still developing tacit knowledge about her job. Younger workers instead rely more on the knowledge they have been “taught” during job training activities (see Lucy’s programmatic behavior). The experienced-based (tacit) knowledge of older workers can be seen as modules in an organization’s memory; such

knowledge should be accessed and used [51] in coordination with the explicitly taught knowledge of younger workers.

The mutual prejudice of Bernard and Lucy towards each other illustrates findings about reciprocal negative attitudes between older and younger workers. Finkelstein et al. [20] found that in simulated employment settings, younger workers tended to rate older workers less favorably when they were not provided with job-relevant information about the workers, and when they concurrently rated older and younger workers. There is also evidence, albeit less so, that older (information technology) workers are likely to have younger managers, which may create tension (older workers view their younger superiors as a threat [48]). Older and younger workers also have different working styles: while young workers have a relatively carefree attitude towards their capacity to work (“just do it”), older workers make more effort to use economical work practices [51].

Oral history, especially personal experience, is a rich medium for conveying tacit knowledge. Bernard responded positively to Lucy’s award, relating it to one of his own work-related experiences that reinforced a point he was trying to make.

In terms of group goals, productivity, and performance, the scenario makes clear that Bernard is more concerned with long-term efficiency and sustainability of work practices, whereas Lucy is focused on short-term goals. Mixed-age groups often offer more advantages over homogeneous groups when the work requires problem solving, because of the complementary perspectives and contributions of different generations [51]. Moreover, mixed-age groups have been observed to achieve a balance between the younger workers’ carefree attitude towards their own work capacity and the more economical methods of older colleagues [51].

Groups are complex systems. With older workers, they are even more complex given their special resources and needs. In the next section, we offer a synthetic approach to help us understand how we might better support older workers in CSCW design.

#### 4. A synthetic approach

Work on supporting older adults in HCI has started with the premise that this population has special usability needs [38]. Considering older workers in a collaborative context allows us to radically change perspective. Rather than presenting problems for productivity, older workers are now viewed as an asset that should not be neglected by organizations or by society [47]. For them, teamwork provides an excellent opportunity for sharing and applying their technical, planning, organizational, and social skills [51]. To analyze how older workers can be better supported by groupware, we need a frame of reference that is grounded in existing models, theories, and frameworks, so that we can better articulate the socio-technical challenges and opportunities associated with

older workers. In this section, we present a synthetic approach inspired by social group theory [3].

#### 4.1. Groups as complex systems

Groups are open and complex systems that interact with the smaller systems (individual members) that are embedded within them as well as the larger systems (organizations) that contain them [3]. The complexity of groups is articulated with respect to three modes of group life (formation, operations, metamorphosis) and three levels of analysis (local, global, and contextual). The three levels of analysis lead to three types of group dynamics: *local dynamics* (the activity of a group's members); *global dynamics* (the evolution of group-level variables that emerge from and shape local dynamics); and *contextual dynamics* (the impact of features in the group's organizational context that will shape and constrain both local and global dynamics).

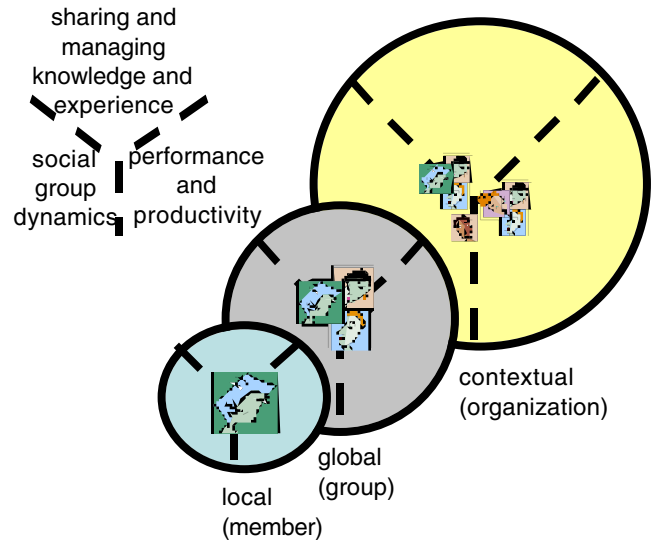
#### 4.2. Extending the theory

We propose an extension of the theory that integrates a socio-cultural perspective on group work. We leverage concepts of *activity* and *artifacts* from literature on activity theory [6, 8, 13, 58]. Activity theory offers useful conceptual tools and a rich perspective for studying group work.

Activity, of which group work is a specific form, is a rich endeavor where human practices and artifacts define one another in a historical context. Artifacts have a social origin (i.e. are generated and transformed within interactions), mediate thought and action, and develop and compose the culture of a group. We distinguish three types of artifacts that result from (and mediate) group work: (1) knowledge and experience; (2) social relationships, norms, and roles; and (3) work products. While performing group work, knowledge and experience are generated and exchanged among group members (they learn from each others' skills). Social relationships, norms, and roles are created, sustained, and transformed as well (members create affiliation in the group). This aspect also encompasses socio-emotional phenomena including social emotions of the members and emotional group dynamics [4, 7] that affect patterns of interaction and work relationships. Finally, the group achieves its production function by generating and exchanging work products (e.g., a project report). We do not claim that the three types of artifacts are exhaustive in describing group work, yet they represent fundamental outcomes of group activities.

Arrow et al.'s group theory [3] uses a three-level categorization of local, global, and contextual levels of analysis (the three circles in Figure 1). In our extension of this theory, at each level, we distinguish three distinct themes (the three partitions in Figure 1): *sharing and managing knowledge and experience*, *social group dynamics*, and *performance and productivity* (Figure 1).

The three themes allow us to synthesize the major resources that older workers contribute to coworkers, groups and organizations. For example, older workers often carry with them : (1) domain knowledge and practical expertise in dealing with ill-defined situations; (2) experience in working with others, negotiating, integrating differences and resolving conflicts among colleagues; (3) long-term planning skills and economical work strategies. The literature on work and organization has called for more attention on the silent crisis that the aging of workforce is causing: irreplaceable loss of knowledge, experience, skills and wisdom and, a consequent loss in productivity and effectiveness [46].



**Figure 1.** Synthetic approach: the three levels of analysis of groups (represented as circles) and the three themes (partitions within each circle).

#### 4.3. Perspectives on groups

Groups can be defined in terms of functional, structural, and developmental aspects. *Functional aspects* refer to the purpose and functions of a group, i.e. groups serve more than one purpose or function (e.g., [25, 35]). *Structural aspects* refer to the composition of groups. Groups are more than just a collection of individuals. They are systems interconnecting members, tasks, and artifacts in complex patterns (complex systems). Additionally, they constantly maintain two-way interchanges with both the embedding context (i.e. organization) (e.g., [2]) and the group members (adaptive systems). *Developmental aspects* refer to the lifecycle of groups, which develops and changes over time (e.g., [32]).

Some group theorists [3, 35] have used the levels of analysis (local, global, and contextual) to describe the functional aspects of a group. They have observed that groups at work carry out three simultaneous functions: (1) member-support, contributing to the individual members of the group (e.g., the members develop and maintain

stable interpersonal relationships); (2) group well-being, contributing to the life of the group itself (e.g., the members assume roles and develop behavioral norms which regulate the group); and (3) production, contributing to the larger organization in which it is embedded (e.g., the group completes a project assigned).

Extending this group theory we view the group functions not only through levels of analysis (whose needs are served) but also in relation to work artifacts (what is generated and exchanged). Indeed, the three themes mentioned above (Figure 1) were obtained by considering the functional role of the different types of artifacts. Functionally, knowledge and experience need to be shared and managed within the group; creation, sustenance, and transformation of social relationships is the base for social group dynamics; and work products are outcomes of group performance and productivity.

In addition to a functional perspective, groups can be described structurally as a system of three elements: members, tasks, and resources. Such elements are interconnected in complex patterns. Moreover, adopting a developmental perspective groups can be viewed as dynamic systems that evolve under the influence of three levels of causal dynamics: local, global, and contextual. Articulating the dynamics at different levels of analysis is useful for conducting systematic investigations of multiple causes and effects. For example, the older worker may build stable social interactions with their colleagues, which, at a global level, may result in increased social integration and group stability. On the contrary, studies have shown that at an organizational level, supervisors may perpetuate negative perceptions of mature workers by reserving opportunities for career advancement for younger employees; this can have a strong impact at both the global (introducing conflict in the group) and local level (reinforcing age-related stereotypes in the members) [42].

Using this developmental perspective as a longitudinal view on groups, Arrow et al. conceive groups as characterized by their own life course which includes three relatively sequential modes of life: formation, operations, and metamorphosis. The “life stage” of a group is a crucial factor in choosing strategies that best support its functions and well-being. For example, during group formation, an effective strategy to support efficient knowledge transfer between a domain-expert older worker and a tool-expert younger worker might be collaborative tools for one-to-one coaching, apprenticeship and constant supervision, encouraging mutual exchange of expertise. In contrast, during operation and metamorphosis modes, other tools (e.g., stories) might provide more effective knowledge transfer among the members.

## 5. CSCW design implications

Thus so far, we have elicited the dire need for the CSCW community to address the challenge posed by older workers. Our synthetic approach is a contribution of a plausible theoretical foundation that will lead to design

implications. Now remains the challenge of translating design rationale into an initial ensemble of design implications that will orient future design of groupware to leverage the capabilities of older workers.

Our design discussion is organized by a series of micro-scenarios that react to the problem scenario presented earlier. The three themes are inter-twined, so we do not attempt to address each theme independently, rather each micro-scenario addresses issues in multiple themes. Clearly, we do not attempt to be exhaustive in these design scenarios—our goal is to evoke design insights, set up initial ground for future research, and initiate a theory-based discussion of how to best leverage the opportunities of older workers in CSCW.

### 5.1. Asynchronous communication backchannel

Different generations use language differently and hold differing interpretations of work practices; they share only partial overlap in knowledge, work experiences, and social norms. Creating an infrastructure for bridging these cross-generational gaps will be essential in establishing and maintaining common ground.

A component of such an infrastructure that supports common ground is an asynchronous communication backchannel where younger and older workers can communicate in a self-paced manner, build on common previous experiences, and develop a common vocabulary. Such a backchannel would likely be a secondary computer-mediated communication channel that supports existing workplace practices of synchronous collaboration (whether face-to-face or computer-mediated) (e.g. an Instant Messaging client). An asynchronous communication channel allows users to negotiate social norms, exceptions, and breakdowns among themselves [1], making the collaboration context more flexible, persistent, and amenable to different paces for comprehending, assimilating, planning, and responding. Moreover, the Group Support Systems research has observed asynchronous computer-mediated communication appears more effective than face-to-face when used with tasks requiring decision-making [21]. Consider the following micro-scenario.

*Bernard and Lucy have been communicating about tax form anomalies using a Wiki. They both develop a coding scheme to categorize these exceptions. Lucy adds an exception to the list that seems bizarre to Bernard. Looking at the graph that indicates how many changes have been made to the document so far, Bernard decides to modify their coding scheme for future, unanticipated anomalies. While refining the coding scheme, Bernard thinks through Lucy's suggestion and acknowledges its value.*

In this micro-scenario, Bernard and Lucy use a Wiki (collaborative web editor [24]) for asynchronous communication, creating a backchannel in which they can negotiate views about anomalies and develop a common

understanding and interpretation. The outcome of using this communication backchannel in the long-term is to increase the overlap of work experiences. Moreover, the availability of an asynchronous mechanism supplements synchronous collaboration enabling differential pacing in group work. Such an asynchronous mechanism has specific advantages for supporting learning in the workplace. By slowing down interaction, group members are given time for reflection, and ideas, questions, comments, etc. can grow and mature before being shared with other colleagues [26]. Providing visibility of communication exchanges enables learning and greater efficiencies [1, 28].

An asynchronous backchannel introduces specific constraints within the communication that promote common ground and mutual understanding [12]. Using this type of tool, coworkers can adequately define their thoughts by writing and revising their messages on the tool, and review and reflect on each other's contributions to appreciate their value.

The system also allows the experienced worker to become more aware of the work distribution over time (detecting the high frequency of changes through the graph). Leveraging such "activity awareness" [11], he/she can help the group to plan ahead more strategically and incorporate changes in current work activities.

Finally, the design of an asynchronous communication backchannel relates to the knowledge and experience and social group dynamics themes in our synthetic approach at a global level of analysis. The affordance for co-construction of shared meanings and artifacts creates a greater understanding between the members and at the same time promotes a stronger "affiliation within the group" [3], which in turn furthers the achievement of collective goals of the group.

## 5.2. Multiple ways of tacit-knowledge transfer

The heart of any knowledge-retention strategy is its knowledge-sharing practices [17]. This can be achieved through face-to-face meetings, video conferencing, written reports, communities of practice [59], and apprenticeship among others [17]. While many of these practices are useful for generally sharing knowledge, the question remains which ones are the most useful for sharing the tacit knowledge held by older workers.

Multiple tools should be provided to transfer and retain tacit knowledge. In one online senior community, members appreciated the availability of a multitude of communication affordances [40]. Storytelling and apprenticeship have been acknowledged as effective methods for transferring tacit knowledge from veteran workers to others [17]. The importance of providing a range of tools for transferring tacit knowledge is consistent with our synthetic approach of groups as dynamic systems where older workers undergo different stages of integration within groups. In early stages when

the group is in formation or the older worker just joined the group, an effective knowledge transfer strategy of tacit knowledge can be promoted by using one-to-one coaching or apprenticeship. This is particularly advantageous when there are conditions for mutual transfer. For example, older workers can provide younger colleagues with domain experience and younger workers can provide contemporary skills. As the older worker is fully integrated within the group and a shared language is developed, apprenticeship may yield new strategies of knowledge-transfer. An appropriate candidate could be storytelling because it leverages the evocative and informal nature of stories to synthetically convey aspects of previous experiences that are relevant to the current context. Consider the following micro-scenario.

*Bernard asks Lucy how to classify tax forms of an international entrepreneur. Bernard is unable to use the advanced tool feature in the way Lucy explains it to him. Using a desktop sharing facility to mirror Lucy's demonstration of using this feature, Bernard observes that she involuntarily uses a shortcut key to activate some of the feature options. In turn, she sees how Bernard classifies a tax case unfamiliar to her.*

By using a desktop sharing facility, Bernard and Lucy could see each other's interactions on their respective computers, including tacit knowledge that may be difficult to realized and articulate on demand. This gives both an opportunity to learn more about each other's specialized experience and skills.

Tacit knowledge as organizational memory is an important element of an organization that should be stored by suitable means [51]. In contrast to the notion of organizational memory as a passive store, Bannon and Kuutti argue for an active construction of common information spaces from information repositories [5]. Consider the following micro-scenario.

*James, a new employee, reads the stories that Lucy documented as best practices using her online project log, including stories that Bernard had told about his previous work experiences. Unable to understand Lucy's summary of a story where Bernard won a bonus for his "inefficient" process, James chats with Lucy to understand what she meant and what Bernard did.*

Organizational memory as an active and constructive activity has implications on the ways in which information is initially produced and stored and subsequently interpreted and understood by other people, in other settings, at other times [5] (such as James being new to the workplace). If tacit knowledge can be articulated, it can be stored using computers; but reusing this knowledge requires a shared interpretation between the involved actors. CSCW systems can assist in developing common interpretations by allowing access not just to the shared artifacts (such as stories in our scenario) but also to the actors themselves and to the original context in which the artifacts were generated [5].

### 5.3. Supporting exception handling

Much of office work is handling exceptional situations [52]. Older workers are sensitive to exceptions. Given their experience, they are able to recognize work conditions deviant from the norm. Besides accumulation of knowledge, older workers have developed efficient strategies of work. Klein, in his model, claims that people use their experience to evaluate a situation, and then form a sense of “typicality” [30]. Older workers are essentially domain experts that rely on previous cognitive schemas that allow the recognition of familiar work situations. Consider the following micro-scenario.

*While they are processing tax forms independently in the shared workspace and Lucy’s status bar shows that she just started entering a new customer, Bernard notices a huge dollar amount deviation from the daily average in the visualization of Lucy’s work process, in combination with a large number of dependents which places the customer in the wrong tax bracket.*

Expert decision-makers are able to recognize which situations are typical and proceed to take appropriate action [30]. Older workers tend to be more expert; they understand what goals make sense, which cues are important, and the typical ways of responding in a given situation [30]. In the above micro-scenario, the visualization supports “workspace awareness” [23] that in turn cues Bernard to recognize and address the exception.

With respect to our synthetic approach, older workers who are sensitive to exceptions can increase group performance and productivity by leveraging their prior knowledge and experience of anomalous situations that they have internalized as memory triggers. Instead of focusing on supporting the communication of exceptions (which is important by itself), we are conjecturing here that CSCW design should consider how to amplify the *sensitivity of older workers* so as to better support their normal process of recognizing cues, recalling memory triggers, and reacting appropriately.

### 5.4. Visibility of work

Older workers are reentering the workforce and will possibly accept positions lower in status to their previous jobs (as in our problem scenario). Suchman observes that in the case of many forms of service work, it is evident that the better the work is done, the less visible it is to those who benefit from it [53]. Another classical finding is that people will not share information in the absence of a suitable organizational reward structure [41].

During training, older workers’ desire to learn may be impeded by fear of failure or feelings of inadequacy as compared with younger workers. Trainers can help alleviate feelings of fear or inadequacy by providing continuous positive feedback and reminders of training goals [50]. Consider the following micro-scenario.

*While they are documenting exceptions from last month, Bernard has an insight triggered by one of Lucy’s*

*questions and records this as a footnote. After a few months, their supervisor, intrigued by the potential efficiency gain of his insight, schedules a meeting with Bernard to ask more details. Bernard, flattered by this gesture, shares his enthusiasm with Lucy and wants her to attend the meeting as well.*

Bernard has an incidental insight triggered by Lucy. Recording such an insight with a computer-supported medium made their work visible and acknowledged mutual contributions. The footnote is a visible trace of collaborative work that is a cue for giving credit at an organizational level. Moreover, Bernard is also able to propagate his reward to Lucy. In this scenario, small incremental costs in collaborating are compensated by derived benefits [1].

Visibility of work in terms of incentives and rewards is critical, especially in cross-generational groups where older and younger workers have mutual prejudice for each other and have the surmounting task of finding common ground to bridge their differences. A classical finding in CSCW is that managers and workers may not share incentive or reward structure; systems will be less used than desired if this is true [1, 22].

Making work visible and being rewarded for the work performed are interrelated phenomena that take place across multiple levels of analysis during collaboration. The visibility of work generally emerges from local to global levels. In the scenario above the insight occurs at the local level (individual), is then shared with the colleague (group) in context of their collaboration, and later is integrated within the work product (as a footnote) as organizational documentation (contextual). On the other hand, the rewarding structure of the group may operate in the opposite direction: as the organization acknowledges the value of the work product, this may influence both global and local dynamics of the group (a member is acknowledged and s/he shares the credit for the work with the group). Hence, in this case, making work visible triggers a rewarding for the members and the group. This in turn can encourage the members to make more visible their work, and create a cyclical positive feedback. However, additional factors can also mediate this cyclical process such as prejudices, dysfunctions in rewarding systems, member’s need for anonymity, conflicts between members, etc. A good design for mixed-age groups should promote positive feedback between visibility and rewarding, and mitigate negative the effect of negative factors.

## 6. Discussion

The design of interaction between an individual and a computer (HCI) is complex. Designing for collectives (CSCW) is further complicated and adding diversity to the collective adds even more perplexity. As people age, the range of capabilities and incapacities is progressively widened. Older workers have different combinations of variable competencies and deficits. Thus the challenge for

designers is to balance these combinations by capitalizing on the competencies while simultaneously compensating for deficits. However, we have seen that the most challenging design issues are not about older workers but rather the larger context within which they are embedded. Designing for groups that include older workers requires us to account for the already complex nature of group work, plus the idiosyncrasies introduced by the presence of older workers. It is also important to consider that aging is associated with substantial individual variability in performance and that older adults as a group are very heterogeneous. In fact, for many indices of performance, there are greater differences within the older population than between older and younger age groups [15].

Let us now consider the tradeoffs in the design implications we presented earlier. An asynchronous communication backchannel could be intended for building common ground, but backfire if there is misinterpretation in communication. For example, while using such a channel such as a message board, consider a young worker that dismisses an idea of his older colleague (an older worker) by posting the following message “This idea sucks because it’s too old-fashioned”. The two colleagues could interpret this posting differently due to their different meaning systems, as the younger worker may have meant it simply as a humorous remark, the older worker could take it as disrespectful and a stain on his reputation. This could result in unintended consequences such as conflict, reinforcement of mutual age-related prejudice, and possibly disaffiliation of the older colleague from the younger.

In supporting tacit knowledge transfer in multiple ways, context of this knowledge may be misinterpreted. Consider a variant of the scenario in section 5.2 where James does not chat with Lucy after reading Bernard’s story, and believes that he can still be recognized for his work even though it may be inefficient. Designers can also wrongly assume that workers will be willing to share their knowledge; for example, an older worker that just joined a new company may be “passively resistant” [37] in sharing his past experiences until he/she familiarizes with group members and the environment. In this case, tools should be designed to evoke knowledge sharing by relating to current work practices and experiences. Similarly, mutual apprenticeship can prove to be an effective method of training, but such a technique in practice is financially difficult to sustain for an organization [17]. In supporting sensitivity for exceptions, designers have to consider the age-related declines of older workers. Providing additional information to support their awareness may result in cognitive overload and inefficiency.

The tendency of the older worker to nitpick exceptions can frustrate the younger worker and possibly hinder his/her performance. In supporting visibility of work, designers should consider that the expected advantages of visibility may not occur for several reasons: people may not want to share contributions to avoid exposure to

criticisms [1]; and people can misuse the opportunity of visibility for personal benefits (e.g., unauthentically make work visible just for the sake of receiving credit). There can also be an unequal distribution of doing the work and receiving the benefit [22].

The three themes (sharing and managing knowledge and experience, social group dynamics, and performance and productivity) in our synthetic approach are mutually interdependent. They require designers to identify thematic tradeoffs for each specific design. For example, a design that gives precedence to social group dynamics (e.g., providing multiple communication tools) over other themes may result in a performance and productivity cost. This is because group members spend more time in communication and less time doing productive work. On the contrary, if the design gives precedence to performance and productivity (e.g., providing tools exclusively supporting task execution), this may incur a cost in sharing knowledge and developing social relationships. Not considering these thematic tradeoffs may result in expensive design failure. One way of addressing these tradeoffs is to develop a value system that allows for judging the appropriate distribution of design support for these themes. For example, the observation that routine tasks are better accomplished by homogeneous groups versus problem-solving and creative tasks by cross-generational groups [51] would lead to at least two different design arrangements with respect to the three themes. For routine tasks, precedence would be generally given to performance and productivity, as opposed to social group dynamics for tasks requiring problem-solving and creativity (e.g., brainstorming would require efficient system support for communication). In general, for each arrangement, the distribution of design support will probably be unequal among the themes, yet be amenable to the primary goal of the group.

A group is an evolving entity. As a group develops through its various life modes (formation, operation, and metamorphosis), they tend to become more complex—which means that the number and variety of regularities in structure and behavior proliferate [3]. Cross-generational groups will increase this complexity. Diverse groups, such as with older workers, prolong the formation process in a group [3]. In the long run, this diversity increases the flexibility and life path multiplicity [38], meaning that there will be a larger range of possibilities available for group evolution. On this basis, we argue that designing for cross-generational groups impedes attempts to predict and generalize possible snapshots of the group’s status in its developmental life cycle. Therefore, given the ambiguity of this complexity, a promising approach for CSCW designers is to design temporal systems that afford co-evolution with the nuances that drives the group development (“dynamic flexibility” [19]).

## 7. Conclusion

We have shown that age-related diversity in groups makes the design a complex enterprise. This difficulty represents just a part of a much larger challenge of designing for workplace settings that are increasingly becoming diverse [42] and rapidly changing. In addition to age, other types of diversity (e.g., gender, race and ethnicity, language and culture, disciplinary backgrounds) are also transforming the workplace settings. Design needs to incorporate the multitude of diversity types. Moreover, designers should also consider the consequences of the transformation occurring in the workplace such as new models of employment between full-time jobs and retirement (e.g., job sharing), new roles for workers (e.g., organizational historians) and alternative career paths, and an increasing overlap between work and learning (e.g., training and re-training).

Lev Vygotsky believed that the lifelong process of development was dependent on social interaction and that social learning actually leads to cognitive development—in a simplistic way, once we stop learning, we stop developing. Would it not be a shame if we stop learning, and consequently stop developing, at the age of 65 or so when we will have another few decades to live (to say the least)!

In this paper, we have argued that CSCW needs to enhance its understanding of older workers, the next major frontier for the field. This cannot be realized without first acknowledging the problem. We hope our contribution, in the form of sound literature analysis, theoretical underpinning, and design rationale, implications, and tradeoffs, renders plausible appreciation to this emerging phenomenon of older workers and the challenges it poses to the CSCW community.

## 8. References

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