Journal of Evolutionary Economics
https://doi.org/10.1007/s00191-021-00738-3

REGULAR ARTICLE

Institutional adaptation in the evolution of the 'co-operative principles'

Timothy Waring [1,2] · Taylor Lange [3,4] · Sujan Chakraborty [2]

Accepted: 7 July 2021/Published online: 31 August 2021

Abstract

The 'co-operative principles' are a set of operating and aspirational guidelines for co-operative businesses that originated in England in the 1840s and are used worldwide today. We evaluate alternative explanations for their emergence and spread. One hypothesis is that the co-operative principles constitute institutional adaptations helping co-operatives survive and spread. Alternatively, the principles might be adaptively neutral but spread fad-like between co-operatives, or they may spread even while hampering co-operative survival, constituting a maladaptation. We use established empirical rubrics to identify the preconditions and signatures of adaptive evolution in the co-operative principles in their 170-year historical record. Historical analysis provides compelling evidence of the variation, transmission and selection of the co-operative principles in various periods and environments. We document that the principles arose and have been modified via intentional innovation, that they sometimes work to facilitate cooperation among the members of a co-operative, and that in some cases they have spread due to their beneficial effects on the co-operatives which adopt them. We also report macro-evolutionary patterns which suggest adaptive evolution may have occurred, including patterns of descent with modification and the adaptive radiation of the principles into worker co-operatives. The patchwork evidence is consistent with a mix of evolutionary processes varying over time, and some principles may have been selected against. We conclude that the co-operative principles likely constituted institutional adaptations as a whole in 1840s England and 1950s Spain but may have only been adaptive in a piecemeal fashion otherwise. We conclude by proposing that the co-operative principles can be revised and improved scientifically.

✉ Taylor Lange
taylor.z.lange@maine.edu

[1] Mitchell Center for Sustainability Solutions University of Maine, Orono, ME 04469, USA

[2] School of Economics, University of Maine, Orono, ME 04469, USA

[3] Ecology and Environmental Sciences, University of Maine, Orono, ME 04469, USA

[4] Center for the Advancement of the Steady State Economy, Arlington, VA 22203, USA

Keywords Co-operatives · Co-operative principles · Cooperation · Cultural evolution · Group cultural adaptation

JEL codes B52 · J54 · P13 · Q13

1 Introduction

Co-operative organizations are distinguished from traditional organizations such as private enterprises in that they are owned and democratically controlled by their members (ICA 2015). Co-operative members also have more stake in the organization than profit dividends (Birchall 2012). A variety of types of co-operatives exist, including worker co-operatives, consumer co-operatives, credit unions, and producer co-operatives. All of these share a common idea that the business should be run by and for the members rather than owners (Birchall 2012; Puusa et al. 2016).

Because of their distinct organizational structure, co-operatives face a special set of additional survival challenges in comparison to traditional businesses or hierarchical organizations. Primary among them is the challenge of group ownership and leadership. Fulton (1990) argued that co-operatives must manage an internal social dilemma that requires cooperation between members, which requires significant extra effort. In this view, co-operatives require cooperation to function effectively while hierarchical businesses do not. Not only must cooperation be maintained, but maintaining democratic function likely comes with added costs as well (Pozzobon and Zylbersztajn 2013). Co-operatives appear to incur still further costs in comparison to traditional businesses, including the costs of ownership (Hansmann 1988), transaction costs (Ménard 2007), and agency costs (Cadot 2015; Grashuis 2020a). These factors may be why co-operatives are generally considered less efficient, less profitable (Grashuis and Su 2019,; Nilsson 2001), less aggressive and less innovative than traditional private firms (Hetherington 1991), and why co-operatives contribute only 4% to GDP globally (UN 2014). Along with the organizational hurdles of collective ownership and democratic control, these additional costs seem to place extra burden on co-operatives, leading to the question: how do co-operatives survive given the extra challenges they face?

One answer that derives from organizational ecology (Hannan and Freeman 1993), could be that co-operatives may occupy a special social and economic niche, thereby avoiding competing directly with traditional firms. One aspect of such a niche might be the profitability. There is evidence that co-operatives serve markets at rates of return below those that proprietary firms choose (Hetherington 1991). Another aspect of a co-operative niche may be social and community involvement. Co-operatives exhibit multiple traits that might make their survival in such a niche possible. For example, co-operatives often cultivate a sense of community that provides social benefits to their members and their community (Birchall 1997; van Oorschot et al. 2013; Puusa et al. 2016). Co-operatives also sometimes behave differently than hierarchical firms. Craig and Pencavel (1992) found that during an economic recession, hierarchical firms laid off workers while co-operatives kept workers but lowered wages overall. Thus, co-operatives appear to exhibit a set of traits oriented toward inclusive community interaction which may help them inhabit a slightly different organizational niche than tradition firms. This suggests that the most successful strategies for managing a co-op

should differ from those for traditional businesses. We do not evaluate the separate niche hypothesis in this paper. Instead, we explore the evolution of one potential trait which might contribute to co-operative survival: the co-operative principles.

The co-operative principles are a set of operational guidelines for co-operative businesses, which are extremely widespread and common among co-operatives of many types. These principles include (1) voluntary and open membership, (2) democratic member control, (3) member economic participation, (4) autonomy and independence, (5) education, training and information, (6) cooperation among co-operatives, and (7) concern for community (International Cooperative Alliance 2015). Our basic question is how the co-operative principles became so widespread. We develop an evolutionary analysis of the global diffusion of the co-operative principles. We organize the available evidence on the evolution of the principles using standard empirical rubrics common to organizational ecology and evolution, institutional evolution, cultural evolution.

Our approach improves on prior case-driven research on cultural group selection. For example, while Richerson et al. (2016) provide broad evidence for the operation of cultural group selection generally across social realms, they do not explore a single case in depth and do not employ structured rubrics. And, while Waring and colleagues (Hanes and Waring 2018; Waring and Acheson 2018) use empirical rubrics to explore group-level cultural evolution in depth within specific industries, they do not track the evolution of single well-defined trait. Our analysis is also deeper than previous research on case-driven group-level cultural evolution because it uses one well-articulated trait which can be tracked over 170 years of historical evolution. Finally, our analysis also refines and integrates prior rubrics on the evolution of group-level cultural traits.

2 Culture, cooperation and the evolution of Organizations

The human capacity to form and maintain culturally organized groups or 'organizations' is unique in the animal kingdom, and it relies directly upon two central human traits: culture and cooperation. Human culture, composed of cultural traits (e.g. behaviors, beliefs, language, values, technology, institutions) can come to fit their social and environmental conditions through a process of cultural adaptation (Boyd and Richerson 1985; Cavalli-Sforza and Feldman 1981). Cultural adaptation occurs when beneficial cultural traits spread more than alternatives through teaching, imitation and learning (Mesoudi 2017). For example, despite being superstitions, some food taboos may have evolved to help individuals avoid toxic foods (Henrich and Henrich 2010). However, not all culture is adaptive. Costly or maladaptive cultural traits can also spread even though they impose a cost to the bearer, i.e. when highly educated people have fewer offspring but are preferentially imitated (Boyd 2016). Cultural evolution provides a general framework for studying the emergence and diffusion of cultural traits at any level from individual behaviors, sports strategy and musical styles to corporate policy and societal governance traits. Cultural evolution is consilient with institutional evolution (Hodgson and Knudsen 2010), organizational ecology (Hannan and Freeman 1993), and generalized Darwinian frameworks for understanding group-level human cultural change.

Cooperation[1] (aiding others) and altruistic behavior (aiding another at a cost to oneself) have been explored at depth by evolutionary theory (Axelrod and Hamilton 1981; Rand 2016). The proclivity with which humans cooperate with non-kin is argued to be one of our signature behavioral adaptations, and is a critical factor in explaining the global success of the human species (Henrich 2015; Turchin 2007). Cooperative behaviors can spread between individuals culturally via learning and imitation (Henrich 2015), and there is evidence to suggest we do so instinctually in time restricted experiments (Rand 2016). The human ability to cooperate in groups and to develop systems to nourish this ability is increasingly considered an important explanation for human social systems, from markets (Henrich et al. 2010) and organized religion (Norenzayan and Shariff 2008) to systems of morality (Curry 2016). Consequently, cooperative human groups, organized by word of mouth and maintained by oral tradition, have likely existed for millennia. Today, modern organizations often have institutions and formal, written rules which maintain cooperation and compliance of participants.

Institutions, such as formal rules, are group-level cultural traits, i.e. they are a property of a group rather than an individual. Institutions are unique to human evolution and integrating cultural prescriptions for cooperative and collaborative interaction in a group. Institutions are thought to evolve in the basic Darwinian sense, varying and spreading between groups, and possibly impacting their success. However, not all institutions are beneficial for the groups that adopt them. Some business management ideas are virus-like fads, spreading rapidly and even carrying net costs, while some have no effect at all but might spread by the random process of cultural drift (Bikhchandani et al. 1992; Lansing and Cox 2011). Institutions with a favorable influence on group outcomes that spread among groups as a result may be considered institutional adaptations. However, economic efficiency is not the only criterion on which selection operates, nor the only dimension of organizational fitness. This sets an evolutionary approach to economic change apart from traditional economic theory. Other factors constrain selection and expand the space of possible economic and social design. For example, social factors (such as the maintenance of shared culture and identity) and governance factors (such as mechanisms to ensure just allocations and decisions) also influence organizational success and survival. Finally, organizational survival and reproduction can be aided by both individual traits (such as cooperation) and group-level traits (such as institutions) and their interactions.

The study of the evolution of co-operative organizations is far beyond the scope of the present article. Instead, we analyze the evolution of the co-operative principles, a codified group-level institutional trait, using available evidence from the global population of English-speaking co-operatives.

3 Detecting institutional evolution

To understand how the co-operative principles emerged and became widespread we must distinguish between three major modes of evolutionary change: neutral evolution, maladaptation, and adaptive evolution. A priori, the co-operative principles might have emerged

[1] We use terms such as "cooperation", without a hyphen, to mean the behavioral act of assisting someone else. We use terms such as "co-operative", with a hyphen, to denote a specific type of organization: a "co-op."

via any of these processes. For example, as group-level traits, the co-operative principles may have evolved as an adaptation among groups via group-level cultural selection (Henrich 2004; Richerson et al. 2016). However, not all group-level traits are adaptations. To avoid adaptationism, the assumption that a cultural trait has spread by adaptive processes (Godfrey-Smith 2001), we must account for the basic components of adaptive evolution individually: variation, selection and inheritance. While adaptive evolution requires all three factors, other modes of evolution may still occur in the absence of selection, including, most notably: cultural drift and the cultural equivalent of gene flow. Thus, we conduct a transparent analysis of the available evidence pertaining to the evolution of the co-operative principles using established empirical rubrics designed for this purpose.

In addition to the factors of Darwinian evolution (variation, selection and inheritance) we utilize two empirical rubrics: Mesoudi et al. (2004) to highlight broad-scale evolutionary patterns indicative of adaptive evolution, and Kline et al. (2017) to organize evidence on group-level cultural evolution. The Kline rubric seen in Table 1 organizes evidence of (A) the necessary preconditions for group-level cultural adaptation, and of (B) supplemental indicators of group adaptation, helping to avoid adaptationist assumptions. Indicators are characteristics, such as cooperation, which are difficult to explain without group-level forces such as group selection. However, as Kline et al. (2017) point out, even when the force of group-level cultural selection is in operation, it may still be overwhelmed by other evolutionary forces such as cultural drift, or individual selection (e.g. see Waring et al. 2017). Mesoudi et al. (2004) explored macro-evolutionary evidence on human cultural evolution from the perspective of the Origin of Species. The authors argue that the same macro-evolutionary patterns which Darwin observed are relevant to cultural evolution, including

Table 1 Two categories of evidence for group-level cultural selection include (A) the necessary and sufficient preconditions of group-level cultural selection, and (B) indicators of group-level cultural adaptation. See Kline et al. (2017) for further discussion of how to empirically detect group level cultural adaptations

(A)	**Conditions**	**Evidence**
Preconditions of group-level cultural selection	(1) Group-structured variation in cultural trait	Institutions, norms, and/or behavior vary by group. This may include variation in terms of presence, intensity, or frequency of the cultural trait.
	(2) Group-structured outcomes	Material outcomes vary by group.
	(3) Differential spread	Selection mechanisms that account for trait proliferation, including natural selection, cultural transmission, and/or migration.
(B)	**Indicators**	**Evidence**
Indicators of group-level adaptation	Co-operative behavior	Behavior that benefits the group at the expense of the individual; especially in the context of a social dilemma
	Enforcement behaviors	Observable individual behavior such as punishment, usage and monitoring rules, and markers of social or resource group membership.
	Institutional reinforcement	Presence of institutions that support (but are not directly a part of) the focal cultural trait, such as social and resource group boundaries and exclusive access, collective choice procedures, dispute resolution mechanisms, or other features facilitating self-governance.

descent with modification, adaptive radiation, and convergent evolution. Structured accounting of this type will help distinguish which evolutionary processes are in evidence.

4 The co-operative principles as institutional traits

Assessing group-level cultural evolution requires a clearly defined group-level trait. In their guidance notes on the co-operative principles, the International Co-operative Alliance (2015) formally states that the principles should not be taken as doctrine, but as a motivating framework for operation that is distinct from hierarchical firms. While institutions are usually defined as formal rules, guidelines that outline rule making processes are also institutions (Hodgson 2019). The co-operative principles also provide a philosophical ethos that differentiate co-operatives from investor-owned firms as owned, run, and for the benefit of their members (Novkovic 2008). In effect, co-operatives should act as firms, but profit their members and their communities rather than shareholders. In addition, the co-operative operates as a social institution that should enhance its members socially by providing community (Puusa et al. 2016). The International Cooperative Alliance reflects this duality in their guidance notes (ICA 2015).

The first incarnation of the co-operative principles acted both as operating guidelines for the business of their originators, the Rochdale pioneers, and as a political statement. The Rochdale pioneers emerged from labor movements such as Owenism and Chartism, which had developed in response to poverty and inequality created by industrialization and capitalism (Fairbairn 1994; Thompson 1994). These principles spread across England and the world, helping those struggling during the industrial revolution by advocating mutual self-help and community. Once codified by the international co-operative alliance, the principles were presented as a unifying narrative, an ethos of democracy and mutual self-help that presented an idea of enterprise and business that stood for the political goals of social justice and the equitable enrichment of society, rather than to benefit the capital class (Fairbairn 1994; ICA 2015).

In practice, co-operatives heterogeneously use the principles to guide their decision making, though a thorough census of their use is still lacking. In general, open membership, democratic member control, member economic participation, education, training and information, and concern for community are seen as central to maintaining a cooperative (Novkovic 2008; Oczkowski et al. 2013). Oczkowski et al. (2013) found that these five principles played a central role in the eyes of co-operative board members in Australia, and Novkovic (2006) found complementary evidence in 3 co-operatives in Canada. However, Kleanthous (2017) found that only 5 of the 30 credit union members interviewed had heard of the principles. This suggests that the principles are not uniformly recognized across the many types of co-operatives.

The co-operative principles provide an exemplary case study because they are clearly defined as institutional trait, and one that has been transmitted between many groups over almost two centuries. Therefore, we should ask if the co-operative principles have spread because they are beneficial to co-operatives (constituting an institutional adaptation), or merely because they are easy to transmit (constituting a fad).

5 Explicit evolutionary analysis

To assess the evolution of the co-operative principles, we apply empirical rubrics from Mesoudi et al. (2004). and Kline et al. (2017) to the history of co-operatives in the United States and Europe, a summary of which can be found in Appendix 1. We report the evidence in each category whether it supports or detracts from the adaptive hypothesis.

5.1 Environment, population and trait

Co-operatives appear to occupy a slightly different organizational niche than traditional businesses, positioned further in the marketplace from high profits but with stronger reciprocal relations with the local community. Co-operative organizations are those that exhibit both shared ownership and shared control. All such organizations constitute the study population. The co-operative principles are an institution (or group-level cultural trait) and may be considered as either a single unitary trait (e.g. "the principles") when presence or absence can be observed, or as a set of individual traits (e.g. "democratic control," and "education" etc.) when more detailed data are available.

5.2 Factors of Darwinian evolution

5.2.1 Variation

The co-operative principles have varied considerably over time and among groups (Table 2). We do not have multiple samples of the principles from any singular time period due to logistical constraints on research, but history reveals many variations over time. These variations appear to have largely emerged from intentional innovation, rather than through errors or chance alterations.

Innovation, intentional change, or 'guided variation,' is not contrary to selection or adaptation (Boyd and Richerson 1985), but generates variation on which selection can act (Hodgson and Knudsen 2010). Birchall (1997) documents the intention of each change made by the International Cooperative Alliance (ICA) to the principles, for example: in 1966 'cash trading' was eliminated to fit the growing trend of effective credit and lending practices; 'cooperation between co-operatives' was added in 1966 to help build a larger co-operative economy; 'concern for community' was included in 1995 as an attempt to make co-operatives a driver of economic prosperity. These intentional changes emerge through accumulated experience from many co-operatives on how the principles are faring in the current environment (Oczkowski et al. 2013).

In a Dawinian process these variants "should be competing for differential representations in the future (Mesoudi et al. 2004,)." For example, the in early co-operative movement many of the Rochdale pioneers were members of the Owenite movement, which influenced the first article of the statues of Rochdale pioneers (Fairbairn 1994). However, this initial vision of the Rochdale Pioneers was gradually replaced by a tendency towards political and religious neutrality, which the ICA defined as one of the co-operative principles in 1937.

Table 2 The four major iterations of the co-operative principles assigned a common functional categorization. The number of principles varies between iterations. The ICA has not revised the principles since 1995. Drawn from Fairbairn (1994), and Birchall (1997)

Rule Type	1860 Rochdale Pioneers (9)	1937 I.C.A. (7)	1966 I.C.A. (6)	1995 I.C.A. (7)
Democracy	The principle of "one member one vote" should obtain in government and the equality of the sexes in membership	Democratic Control	Democracy	(2) Democratic Member Control
	Management should be in the hands of officers and committee elected periodically			
Economic Participation	Capital should be of their own providing and bear a fixed rate of interest	Distribution of the surplus to the members in proportion to their transactions	Equitable return of surpluses to members	(3) Member Economic Participation
	Profits should be divided *pro rata* upon the amount of purchases made by each member			
	Frequent statements and balance sheets should be presented to members			
Education	A definite percentage of profits should be allotted to education	Promotion of Education	Provision of education	(5) Education, training and information
Cash Trading	Market prices should be charged, and no credit given nor asked	Cash trading		
Quality	Only the purest provisions procurable should be supplied to members			
Quantity	Full weight and measure should be given			
Openness		Open Membership	Open & Voluntary Membership	(1) Voluntary and Open Membership
Interest		Limited interest on capital	Limited interest on share capital	
Neutrality		Political and religious neutrality		

Table 2 (continued)

Rule Type	1860 Rochdale Pioneers (9)	1937 I.C.A. (7)	1966 I.C.A. (6)	1995 I.C.A. (7)
Cooperation Between Coops			Co-operation between coops	(6) Cooperation among co-operatives
Autonomy				(4) Autonomy and Independence
Community				(7) Concern for community

5.2.2 Transmission

Evidence for the transmission of the principles between co-operatives is significant. Some examples of indirect evidence include the correspondence between early co-operative thinkers Robert Owen and Charles Fournier, which developed both of their views and influenced the societies that resulted from their work (Desroche 1971). Additionally, the Pioneers expanded their operations to new co-operative stores that appear to have been founded on the principles (Fairbairn 1994). Finally, Chambers (1962) explains how the Cooperative League of the United States (CLUSA) worked to spread the Rochdale model within the United States.

Direct evidence of transmission shows it occurring through two basic mechanisms, imitative social learning and migration. Imitative learning between groups was important for local transmission of the co-op principles. For example, when pre-existing co-operatives in England came in contact with the Rochdale Pioneers, many came to adopt the principles (Fairbairn 1994). Social learning can also occur over large distances with writing and modern communication technology. For example, the originator of the successful Mondragon co-operatives, Arizmendi, learned about Rochdale and the principles through his seminary studies (Whyte 1995). Between-group social learning can also be facilitated by network organizations such as the International Cooperative Alliance, which disseminate the principles globally with via communication technology. One example of this is New Generation Co-operatives, who included membership fees and requirements in their interpretation of the open membership principle. This practice appears to have become codified in the ICA's (2015) guidelines for the co-operative principles, and now membership fees and contracts have become common in co-ops across sectors.

Migration has also been an important mechanism of transmission, especially over longer distances. The Rochdale principles were transmitted to the rest of Europe and Scandinavia when people with co-operative experience migrated from England (Fairbairn 1994), and migrants from Scandinavia used the principles when founding new co-operatives in the American Midwest (Birchall 1997).

5.2.3 Selection

The general mechanism for institutional adaption is group-level cultural selection (Henrich 2004). It occurs when a trait variant causes groups who possess it to

outcompete those that do not in evolutionary terms. Selection on the co-operative principles would be evident if they impacted the survival and performance of co-operatives who hold to them when compared to other firm types or co-operatives who do not. Research on co-operative survival touches on retention of members (Gray and Kraenzle 1998; Nilsson et al. 2017) and operational longevity (Grashuis 2020b; Valette et al. 2018), and measures of performance and market competition indicators such as growth (Kyriakopoulos et al. 2004) and income (Grashuis and Su 2019)..

The broadest evidence for the selection of the co-operative principles is their special role in the historical successes of the Co-op Group and the Mondragon Corporation, two of the largest co-operatives in the world. Both organizations were founded using specially modified versions of the principles and grew to multi-billion-dollar international businesses. In both cases, the modified principles appear to have bolstered their success by retaining membership and contributing to growth. In a smaller case study of worker co-ops in Spain, Guzmán et al. (2020) found that companies who adhere to the principles in operation show significantly greater performance in terms of employee and business growth. These results illustrate that the principles, as a collection of traits, can have adaptive value to some co-operatives in some environments.

Selection pressure might also accrue for or against a *single* principle. One example is the 'cash trading' principle, which contributed to both the operational longevity of the Rochdale pioneers and their performance. Accepting credit was a risky business choice in the 1800s, and contributed to the fall of Rochdale Friendly Cooperative Society (Fairbairn 1994). The Rochdale Pioneers learned from this and altered their practices (and written policy) to stipulate that trading must be conducted with cash (Thompson 1994). 'Cash trading' remained an ICA principle until the 1966 revision when credit had become a more reliable medium of exchange (Birchall 1997; ICA 1966). This shows that market competition caused selection on co-operatives for business-relevant principles, and as the business environment changed, so did the selection for working with credit. Similarly, the education principle may also have been selected for by helping co-operatives retain members. Ferreira et al. (2020) found that in Brazilian dairy co-operatives technical training programs increased member satisfaction and loyalty.

The social and political environment may also select for or against certain principles as they can influence member motivations and constrain a co-operative's autonomy. For example, engagement with the surrounding community was found to be highly advantageous among a group of new generation co-operatives (Merrett and Walzer 2001). Something similar occurred when the CLUSA rejected a push to formally endorse Marxism in 1928 and chose to keep the principle of political neutrality (Chambers 1962). The selective retention of the political neutrality principle appears to have allowed CLUSA co-ops to avoid the ire of anti-communist movements such as McCarthyism, although we have no comparison case.

Importantly, some of the co-operative principles might work to breed cooperation among members, helping co-operatives survive, and thus constituting an adaptation. Several co-operative principles, most prominently member economic participation, cooperation among co-operatives, and concern for community, establish descriptive norms that emphasize cooperation as opposed to free riding. Other principles, such as membership rules can further help to create an effective environment for cooperation. For example, Iliopoulos and Theodorakopoulou show how mandatory membership rules can determine cooperation outcomes and co-operative success (Iliopoulos and Theodorakopoulou 2014).

The "new generation co-operatives" further illustrate how the principles have evolved to support cooperation. Many agricultural co-operatives collapsed in the 1900s when farmer-members sold their goods elsewhere for a higher price. Facing a similar pressure in the 1990s, new generation co-ops increasing investment costs through more structured rights, requirements, and membership fees, increasing the cost of defecting in the social dilemma and the benefit of cooperation, causing more members to cooperate (Merrett and Walzer 2001). This change also coincided with a 'co-operative fever' in the upper Midwest which saw the creation of over 100 new co-operatives of this model (Grashuis and Cook 2018). Grashuis and Cook (2018) explain how many NGCs eventually failed, likely due to liquidity constraints and poor financial structure. We conclude that membership fees, which are now quite common in many types of co-operatives, likely supported cooperation by raising the stake of members in the co-operative venture. Furthermore, similar membership fees and requirements have been institutionalized in co-operative principles guidelines published by the ICA (ICA 2015), which stress that membership entails and rests on certain responsibilities. More recently, membership fees were seen to be associated more with surviving farmer co-operatives in Ghana than with inactive co-operatives (Grashuis and Dary 2021), possibly as a result of group-level cultural selection.

A final piece of evidence shows that the principle of democratic operation appears to have been selected for at least once. First, in early US co-op history, those with democratic management survived longer than those with autocratic structure (Parker 1937). More recently, Kyriakopoulos et al. (2004) showed that Dutch co-operatives which employ the one-member-one-vote interpretation of the democratic control principle appear to have better economic success than co-operatives with share-based voting, though this effect has not replicated in other countries (Benos et al. 2016). Additionally, democratic member control does not appear to impose overwhelming operating or control costs (Chaddad and Iliopoulos 2013), and the feeling of control given to members increases their loyalty and retention (Figueiredo and Franco 2018; Laurett and Franco 2018). Given the evidence, it appears as though democratic control results in a net benefit to co-operative organizations, both through direct economic benefit in some circumstances, and in member retention. These patterns of selection derive from the shared ownership and control of co-operatives and would not be expected among hierarchical organizations. Therefore, the struggle for survival among co-ops works to select the rules, operating principles, and the execution of those principles which confer the best survival advantage to the groups which implement them.

5.3 Macroevolutionary patterns

5.3.1 Descent with modification

Descent with modification is hallmark historical pattern of adaptive evolution in which the features inherited from one generation are modified in a subsequent generation and carried forward to still future generations (Darwin 1859). In other words, descent with modification occurs when the original function of a trait changes or when the trait does not perform its original function anymore (Mesoudi et al. 2004). Descent with modification is readily observable in the history of the co-operative principles, both within and between traditions or lineages (Fig. 1).

The education principle constitutes a prime example of how a trait has lost its original functions and has been repurposed to serve other functions. Rochdale Pioneers'

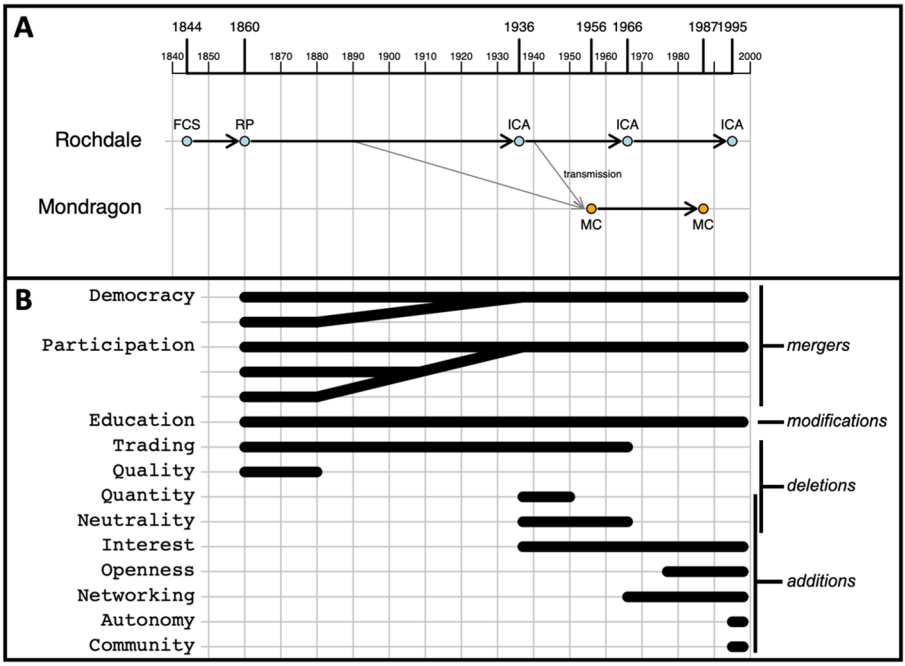

Fig. 1 A) Descent with modification between the Rochdale-ICA and Mondragon traditions. B) Descent with modification within the Rochdale-ICA tradition, showing mergers, alterations, additions, and deletions. Intentionality modifications are still subject to Darwinian processes

vision included "the intellectual improvement of the members" in every respect and in all subjects touching their lives, from science to economics to accounting to co-operative theory. Throughout the nineteenth century, the Rochdale-inspired British co-operative movement emphasized this all-encompassing education training (Fairbairn 1994). But the scope of this principle has narrowed over the time and the current "education, training, and information" principle concentrates on the education related only to the nature and benefits of co-operatives (ICA 2015).

Within the Rochdale-ICA tradition the principles were modified at least four times, with numerous additions, deletions, mergers, and simplifications (Table 2). Even the original principles codified by the Rochdale pioneers were themselves intentional modifications of guiding principles used by the former "Friendly Cooperative Society" (Fairbairn 1994). Other modifications included forbidding trade based on credit, which had caused problems for previous groups. Later, the International Cooperative Alliance altered the principles to make them more accessible across different industries and sectors (Birchall 1997). Further updates in 1966 and 1995 modified the principles to fit current social and economic contexts. Descent with modification can also be observed between the Rochdale-ICA and the Mondragon traditions. The Mondragon version of the principles were adopted from Rochdale-ICA, but were modified likely to suit the different needs of a labor co-operative.

This reconstruction reveals a number of gaps in the historical record. Despite these gaps, the result reveals a pattern of evolutionary descent with modification that conflicts with non-evolutionary models of culture, such as evoked culture (e.g. Gangestad et al.

2006) and cultural attractors (Sperber 1996). In all cases, the modifications were made with clear intent. For example, the elimination of cash trading in 1966 fit the growing trend of effective credit and lending, and the addition of concern for community in 1995 was an attempt to make co-operatives a driver of economic prosperity (Birchall 1997). However, the presence of intentionality does not change the pattern of descent with modification, or the pattern of response to the environment.

5.3.2 Convergent evolution

A final indicator of adaptive evolution is the emergence of the same solution to a similar problem in different lineages or populations. Convergent evolution is a strong indicator of adaptive evolution because it offers an independent confirmation that the evolved trait has adaptive value in a shared environment. The designs revealed by convergent evolution indicate especially effective regions of design space. Examples of convergent evolution abound in the natural world, e.g. wings for flight evolved separately in mammals (bats) and birds, as did swimming flippers in birds (penguins), mammals (dolphins) and fish, and eyes for vision have evolved independently in numerous separate lineages. The institutional design principles derived by Ostrom (1990) provide a probable case of convergent evolution with the co-operative principles. The principles Ostrom described are a distillation of the most important rules observed in natural resource user groups. Thus, Ostrom's rules are reasonably comparable to the co-operative principles because of their origin in a population of groups whose members are socially and economically interdependent.

To consider the possibility convergent cultural evolution with appropriate skepticism, environments and traits must both be compared. First, the socio-economic environments share a central feature: a cooperative dilemma critical to group success. Natural resource user groups face a dilemma inherent in common pool resource (CPR) management, while modern market-based co-operatives face a public goods (PG) dilemma. In both CPR and PG contexts, individual cooperation is necessary for group success, and institutions can bolster cooperation. Thus, both rule sets have evolved in groups where cooperation determined collective success. The economic conditions are not identical, however. In co-ops, free riding is the act of benefitting from but not contributing to the common productive effort and is easily detected. In common pool resource groups, by contrast, overconsumption of shared resources constitutes free riding but can be difficult to observe. Such differences may influence the evolution of each rule set.

The relationships between the functional prescriptions of both sets of principles is categorized in Table 3. We find five one-to-one matches between the two rule sets. The matches are in the domains of membership, participation, group decision-making, group freedom, and between-group relations. Both rule sets contain a rule on membership (CP1, IP1), a group decision-making rule (CP2, IP3), a rule describing appropriate participation (CP3, IP2), an expression of group-level freedom (CP4, IP7), and a rule concerning between group relationships (CP6, IP8). In addition, although voluntary and open membership (CP1) stresses inclusivity, in practice co-ops keep a member list, have membership fees, and behavioral requirements, matching the spirit of clear user-group boundaries (IP1). The principles which were not directly matched are largely explained by the differences between the CPR vs PG contexts, or differences between

Table 3 Five of the seven modern co-operative principles have a 1-to-1 match with Ostrom's institutional design principles. The remaining two are missing in Ostrom either because the focus of Ostrom's research excluded consideration (CP5, education) or due to environmental differences between CPR groups and market-based co-operatives. Three Ostrom principles are not found among co-operatives. Cooperation maintenance rules (IP4 & IP5) may be absent in the co-op principles because free riding is more observable in the public good contribution structure of co-ops than in the natural resource user groups of Ostrom's research. Paraphrased principles are presented in appendix Table 3

Rule Category	Topic Match	Discussion
Membership	1-to-1	Open membership (CP1) and clear boundaries (IP1) both define participation standards. Although IP1 is exclusive, and CP1 is inclusive, standard practice and ICA guidelines both suggest CP1 is typically implemented with membership status and fees, which create a clear list of members, matching IP1.
Group decision making	1-to-1	Democratic member control (CP2) is a specific type of collective choice arrangement (IP 3).
Participation	1-to-1	Member economic participation (CP3) is a general requirement of which proportional costs and benefits (IP2) is a specific implementation.
Group freedom	1-to-1	Autonomy and independence (CP4) and recognition of rights to organize (IP7) both stipulate group-level freedom.
Between-group relations	1-to-1	Cooperation among co-operatives (CP6) and coordination among relevant groups (IP8) both stipulate positive between-group relationships.
Transmission	co-ops (CP5) only	*While co-operatives promote education and training to spread and improve their practices, many of Ostrom's groups were resource-dependent and had a strong culture of resource use. However, education and transmission is still required to maintain the institutions Ostrom describes. Ostrom also sought to explain effective resource use, not institutional longevity. The focus of Ostrom is more narrow.*
External generosity	co-ops CP7) only	*While some evidence suggests that community outreach benefits co-operatives (CITE), external generosity may have different implications among natural resource user groups.*
Cooperation maintenance	Ostrom (IP4, IP5) only	*Co-operatives may not require monitoring (IP4) because free riding may be more observable in public good scenarios than common pool resources where users may extract resources clandestinely.*
Governance	Ostrom (IP6) only	*Possibly implicit in democratic member control (CP2).*

the focus of Ostrom's investigation and the co-operative context. A better comparison could perhaps be made with rules in practice in CPR groups instead of a scientific summary of them.

The comparison with Ostrom's institutional principles reveals that the Rochdale-ICA principles are not unique as group-level cultural traits. In fact, five of seven of the principles have emerged in the natural resource context. Although the case for convergent evolution is incomplete without evidence of isolation between populations, this homology is yet further evidence that the co-operative principles are themselves a group-level cultural adaptation.

Moreover, Ostrom and colleagues specifically argued that the institutional principles constituted group-level cultural adaptations (Wilson et al. 2013).

The congruence between the Ostrom principles and the co-operative principles has been used by researchers to study co-operatives more effectively (Tschopp et al. 2018). For example, Iliopoulos and Theodorakopoulou (2014) show that a mandatory membership policy (conflicts with the Ostrom principles in letter and the co-operative principles in spirit) makes the free rider problem unbearable in a wine co-operative in Greece (Iliopoulos and Theodorakopoulou 2014). Jelsma et al. (2017) found that highly successful small scale palm oil co-operatives can be succinctly described and explained with Ostrom's CA principles (Jelsma et al. 2017). And most importantly, Grashuis and Dary (2021) find that active farmer co-operatives in Ghana exhibit Ostrom's design principles differently than inactive co-operatives. Among other factors, active co-operatives have clearer boundaries, more specific rules, more often pay membership fees (Grashuis and Dary 2021). This literature suggests that Ostrom's design principles may even be superior to the co-operative principles in some regards.

5.4 Assessing group-level cultural adaptation

The evidence for group-level cultural adaptation is summarized in Table 4. As a whole, the co-operative principles satisfy the logical criteria for group-level adaptations in various times and places. The co-operative principles vary in content, interpretation and even number between co-operatives. They have been transmitted between co-ops numerous times and have impacted the success of co-operatives in multiple documented cases. Moreover, the principles appear to promote and stabilize cooperation within co-operatives in some cases, principles 1–3 bear directly on the maintenance of cooperation among members, and five principles are close matches Ostrom's principles which are also known to support cooperation. Moreover, the principles exhibit three hallmark evolutionary patterns, descent with modification (within Rochdale-ICA tradition), adaptive radiation (to Spanish labor unions, United States), and convergent evolution (with Ostrom's design principles for CPR groups). The historical record, therefore, bears a striking pattern of cumulative cultural evolutionary change, but rarely is the evidence complete. We conclude that the principles have constituted cultural adaptations for co-operatives as whole only in 1840's England and 1950's Spain. Generally, the evidence is consistent with a mix of evolutionary processes varying over time, and various principles may have been selected against. The evidence is suggestive that certain portions of the principles (singly or in groups) have been beneficial to co-operatives in a patchwork fashion, especially those which bolster cooperation and enhance education.

6 Discussion

Our review of the historical evidence suggests that the spread of the co-operative principles since the mid 1800's may be partly explained by their beneficial effects on the co-operatives that adopted them, thereby contributing to the adaptive evolution of co-operatives. The evidence suggests that the principles are not entirely neutral, nor do they appear to constitute a costly or maladaptive fad. This conclusion is further supported by evidence for the indicators of group-level cultural adaptation, such as mechanisms to support cooperation and reduce free-riding, as well as the discovery of

Table 4 Evidence for group-level cultural selection includes information on (A) the requirements of group-level selection, (B) the indicators of group-level cultural adaptation such as individual cooperation, and (C) patterns common to adaptive evolution generally. Table adapted from Kline et al. (2017). The co-operative principles have persisted among co-operatives for over 170 years, suggesting that overall, they may have a slight positive effect on organizational success

(A) Requirements for group-level cultural selection

Requirements	Evidence
(1) Group-structured variation in cultural trait	• As rules, each principle is logically a group-level cultural trait. • Different requirements for investment in new-generation co-ops (Birchall 1997) • Voluntary membership principle differed between USSR and ICA (Birchall 1997) • Arizmendi altered the Rochdale model for labor and longevity (Whyte 1995) • Differential use of principles (Chambers 1962) • Changes: disallow credit, build capital, include non-members (Thompson 1994)
(2) Group-structured outcomes	• Use of principles correlated with success (Fairbairn 1994) • 1-member-1-vote rule correlated with profit, growth (Kyriakopoulos et al. 2004) • Open membership principle spurred growth (Fairbairn 1994) • Use of principles correlates with success for Knights of Labor, Sovereigns of Industry, Patrons of Husbandry (Parker 1956; Parker 1937) • Use of democratic principle correlated with survival (Parker 1937) • Co-operative firms respond to recession by cutting wages but keeping employees while hierarchical firms lay off employees (Craig and Pencavel 1992) • Use of credit (principle) caused failure (Fairbairn 1994) • Policy change led to business growth (Thompson 1994) • Use hierarchical practices or political non-neutrality caused failure (Parker 1937)
(3) Differential spread (selection)	• Dissemination of principles with almanac (Fairbairn 1994) • Rochdale principles spread to CLUSA (Chambers 1962) • Rochdale principles spread (with modification) to Mondragon (Whyte 1995, • Whyte and Whyte 1991) • Rochdale principles used to found new co-operatives (Fairbairn 1994) • Scandinavian immigrants opened co-operatives in US (Merrett and Walzer 2001) • Mondragon ideas (not principles) spread to US, UK, ICA (Quigley 2013) • Membership rules (akin to principles) may influence co-op survival in Ghana (Grashuis and Dary 2021)

(B) Indicators of group-level cultural adaptation

Indicators	Evidence
Cooperative behavior	• Co-operatives require member cooperation and principles highlight it. • Decreasing price makes free-riding more attractive, therefore "cooperation" is required in the game theoretic sense. (Birchall 1997)

Table 4 (continued)

(A) Requirements for group-level cultural selection	
Requirements	**Evidence**
	• One member one vote constitutes cooperation in decision-making. • Members pay membership fees and work for the co-operative (ICA ICA 2015) • Similarity with Ostrom's principles governing cooperation in CPRs (Ostrom 1990)
Enforcement behaviors*	• Peer pressure to contribute (Gupta, 2014).
Institutional reinforcement*	• Membership, participation, decision-making principles support cooperation. • Membership fees, responsibilities, etc. (Oczkowski et al. 2013).
(C) Hallmark patterns of adaptive evolution	
Hallmark patterns	**Evidence**
Adaptive radiation	Rochdale principles spread to labor unions in Mondragon, Spain and were modified there. Mondragon became as successful as the Co-op Group.
Descent with modification	Modifications to the principles have been passed down over time, creating a pattern of accumulated changes, or descent with modification. Fig. 1.
Convergent evolution	The co-op principles share 5 major functional similarities with organizational principles that emerged among successful common-pool resource groups.

hallmark patterns of adaptive evolution including adaptive radiation, descent with modification, and convergent evolution.

It is important to contextualize and qualify this conclusion. We are not suggesting that the co-operative principles are the primary driver of success among co-operatives. Many factors determine the success of co-operatives, including business strategy (Benos et al. 2016), the strength of local competition, and membership characteristics, among others. Such factors may drive co-operative business outcomes far more than the co-operative principles do. But adaptive evolution can occur when small effects accumulate across a population, over long periods. The co-operative principles might have spread via adaptive group-level cultural evolution even while only weakly beneficial, and even though other factors are stronger determinants of the success of individual co-operatives. In addition, because adaptive change depends on relative fitness, the principles might have spread via adaptive evolution even as the global population of co-operatives declines, so long as they enhance the survival and reproduction of co-operatives. Moreover, we are not suggesting that the principles have been uniformly adaptive for all co-operatives, or in all contexts. Some principles may be costly overall. The strongest case for the principles as adaptations comes from the 1844 codification, which appears to have been directly beneficial by clarifying solutions for co-operative challenges, in facilitating their modification, and by helping co-operatives multiply.

As a qualitative evaluation of the literature, our approach is limited. First, the literature may itself be biased, which would bias our evaluation, and there is also no way to ensure that we have not missed relevant literature or evidence. Second, qualitative analysis is prone to interpretive error. We have attempted to lessen this problem by using established and transparent empirical rubrics, and by searching for evidence against the adaptive hypothesis. However, future research is necessary to overcome this limitation. We believe that sufficient data for a quantitative study of the evolution of the co-operative principles do not currently exist. Collecting such data was also beyond our capacity. However, we are hopeful that a more refined and quantitative analysis can be made to test our conclusions with quantitative rigor. For example, with sufficient data a phylogenetic analysis (e.g. Collard and Tehrani 2005; Tehrani 2013; Youngblood et al. 2020), or survival analysis (Giot and Schwienbacher 2007; Grashuis 2020a; Iwasaki and Kočenda 2020; Tavassoli and Jienwatcharamongkhol 2016) might become possible with respect to the co-operative principles.

7 Conclusion

This research adds to the literature on institutional evolution from an explicit, cultural evolutionary perspective, in multiple regards. We contribute to applied cultural evolutionary research by exploring a specific institutional trait in a well-defined class of organization (co-operatives). Our approach advances case-driven research on group-level cultural evolution with a complex and well-defined trait that allows for deeper analysis. And, we have synthesized evolutionary rubrics for future applied institutional evolutionary research. The proposition that institutions evolve is itself quite basic, but an evolutionary framework can help make cause and effect in institutional change more transparent.

We believe applied cultural evolutionary analysis can be valuable for society, and specifically for co-operatives. We think that co-operatives can use this and similar research to improve the institutional rules they employ. Our explorations suggest to us that the co-operative principles are imperfect, and in some cases possibly even mal-adaptive. Therefore, co-operative organizations such as the ICA would do well to reconsider the principles in the light of the modern science of cooperation and Ostrom's institutional design principles especially.

APPENDIX

Institutional adaptation in the evolution of the 'Co-operative Principles'.

Waring, Lange, & Chakraborty.

A History of Co-operative Principles.

A full history co-operative organizations is far beyond the scope of this paper, though Birchall (1997) provides a fairly comprehensive history of co-operatives through the twentieth century. We sketch a history of the co-operative principles, so to investigate whether they have had any influence on the co-operative success.

Rochdale Society of Equitable Pioneers.

The co-operative principles likely have multiple sources (Davidovic and Cooperative Union of Canada 1966), and they contain echos of many co-operative style movements within Europe. Prior to the formalization of any principles, socialist responses to industrialization and capitalism fomented in many parts of Europe (Calhoun 1993). Among the leaders of these were Robert Owen, an English socialist thinker who corresponded with many others in Europe about industrialization and his versions of socialist utopias (Thompson 1994). Though Owen's vision of a social communitarian was secular in nature, his correspondence (sometimes agonistic in nature) with religious socialists including Charles Fournier in France, helped to influence his view of how society should be organized (Desroche 1971).

The first iteration of the ICA's co-operative principles appear to have first emerged in 1844 with the "Rochdale Society of Equitable Pioneers" in the town of Rochdale, England (International Cooperative Alliance 2015). Fairbairn (1994) and Thompson (1994) describe their inception in detail. The town of Rochdale was a producer of hand-woven flannel prior to the industrial revolution and a center of co-operative experimentation and thought. But the mechanization of textile looms and American import tariffs crippled the demand for handwoven flannel, and lead to a loss of wages and employment for the majority of the town, resulting in poverty, hunger, unrest, and violent protests in 1808 and 1829. These dismal conditions made the town of Rochdale fertile for the Owenite and Chartist labor movements (Fairbairn 1994; Thompson 1994). In an effort to provide for the community, 60 weavers and Owenites opened a co-operative store called the "Rochdale Friendly Cooperative Society" in 1830. This store lasted for two years, but unsuccessful use of credit and overwhelming debt eventually led to its demise (Fairbairn 1994).

Then in 1844, weavers and Owenites together founded a similar "mutual self-help society" and wholesale goods store. This new "Rochdale Society of Equitable Pioneers" had the same goal as the "Cooperative Society" of improving economic conditions for weavers, but also aimed to succeed where the prior venture had failed. They conjectured that the "cooperative society" failed because it limited its transactions to members, worked in credit, and did not focus on profit. The Pioneers decided to alter these practices by allowing non-members to trade, dealing strictly in cash, and striving to produce a capital surplus. These three policy changes brought increases in revenue and allowed the pioneers to expand their business (Thompson 1994).

From 1845 to 1850, membership rose from 74 to 600, and sales from the store grew 18-fold to £13,180. Fairbairn (1994) postulates that this substantial growth was due to the society's policy of openness and inclusion, which allowed them to absorb membership from several of the towns collapsed educational, political, and economic organizations. This growth continued after 1850, and with it came the opening of new stores in different communities. In 1863, the pioneers joined with other retail-oriented co-operatives to form the Cooperative Wholesale Society, to focus on the wholesale business. The Cooperative Wholesale Society also saw immense growth, diversifying to retailers and manufacturers, and expanding to 584 separate groups by 1878, and again to 1065 in 1940 (Fairbairn 1994). The Society has since grown to become The Co-operative Group, a multibillion dollar consumer co-operative with over 70,000 employees, and 4.6 million members which shares organizational continuity with the Pioneers (Co-op Group 2017).

The Pioneers had developed a founding set of bylaws which they disseminated to other groups through the publication of an almanac of rules of practice. The 1860 edition of this almanac had the earliest version of what could be described as the co-operative principles. These rules of conduct were later synthesized and codified by the International Cooperative Alliance in 1937 (Fairbairn 1994). Since that time, co-operative organizations have adopted and revised the principles that came from Rochdale, and the original Pioneers held in esteem (ICA 2015). Table 2 compares four historical versions of the principles.

Co-operatives through the Great Depression.

The formation of consumer and producer co-operatives in the United States during the 1800's and early 1900's was slow relative to UK and the rest of Europe. Early co-operative societies often failed. Birchall (1997) argues that these failures were attributable to a lack of familiarity with co-operative organizations, the American culture of individualism, and spread of exploitative enterprises that masqueraded as co-operatives. These early co-ops were isolated from each other, and only a few followed Rochdale's ideals, such as the "one member, one vote" rule (Chambers 1962; Parker 1937). Two successful co-operative organizations which did follow the Rochdale principles included the Knights of Labor and the Sovereigns of Industry, two labor unions who opened stores to give their members the benefits of wholesale priced goods (Parker 1956). By 1875 the Sovereigns of Industry had grown to over 300 separate groups many of which ceased to be co-operatives because of their financial success (Parker 1937).

In 1916 co-operative enthusiasts James and Agnes Warbasse formed the Cooperative League of the United States (CLUSA) to provide the co-operative community with greater coordination and dialogue. The League was organized using the Rochdale principles, and brought together many individual co-operatives and co-operative networks across the United States (Chambers 1962). Immigrants from Scandinavia brought experience of consumer co-operatives from Europe and were important in the early days of the CLUSA (Parker 1937). The League considered abandoning the Rochdale model in favor of a top-down, autocratic structure similar to traditional American firms (Parker 1937). However, the autocratically inclined co-operatives eventually suffered bankruptcy (Parker 1937). The CLUSA also experienced political pressure from communists whose effort to remove the Rochdale principle of political neutrality was narrowly defeated in 1928 (Chambers 1962).

From the onset of the great depression through the early 1930's, consumer co-operatives and CLUSA membership saw a 35% increase in membership to 1500 societies and 750,000 members (Parker 1937), which was even exceeded by co-operative growth in Europe (Hilson 2013). "Self-Help" co-operatives, reinforced by federal grants from the Federal Emergency Relief Administration, supplied food and work to over half a million families across 37 states, many of which made the transition to consumer co-operatives (Parker 1956). These co-operatives accounted for some of this slow but steady growth through the early thirties, and the growth was highest where there was cohesion and cooperation between co-operatives (Parker 1956). Agricultural purchasing co-operatives, formed to lower input costs by sharing supply purchases also boomed during the depression (Parker 1956; Parker 1937), with purchasing growing more than 3-fold to $250 million in a decade. New Deal legislation

also expanded agricultural co-operative purchasing power, and aiding many farmers during the depression (USDA 1999).

The Mondragon Corporation.

An important part of co-operative history comes from the worker co-operatives of the town Mondragón in Spain's Basque country. In 1956 an industrial worker co-operative was founded by the students of social organizer and priest José Arizmendiarrieta (Whyte and Whyte 1991). Arizmendiarrieta had earlier learned of Rochdale and the co-operatives principles during his seminary studies. He was concerned that although the Rochdale consumer co-operatives were successful, the Owenite worker co-operatives (industrial textile firms) had reverted to private ownership (Whyte 1995). Drawing on humanist and Catholic social thought (Herrera 2004), Arizmendiarrieta sought to improve on the Owenite model so that new co-operatives could endure as co-operatives (Whyte 1995). The successful co-operative sparked similar efforts in other domains, which eventually grew into a flourishing confederation of co-operatives.

Mondragon worker co-operatives have a distinct structure and organizational culture. Although worker owned and democratically controlled, Mondragon co-operatives use elected democratic leadership to govern businesses affairs (Whyte and Whyte 1991). These differences extend to their guiding principles as well. In 1987 Mondragon formally approved a set of ten principles which Whyte and Whyte (1991) argue were modified from those of Rochdale. They are: (1) Open admission, (2) Democratic organization, (3) Sovereignty of Labor, (4) Instrumental and subordinate nature of capital, (5) Participatory management, (6) Payment solidarity, (7) Inter-cooperation, (8) Social transformation, (9) Universality, (10) Education (Mondragon Corporation 2017a).

The Mondragon model was extremely successful (Whyte and Whyte 1991). Since the 1950s, the Mondragon co-operatives have achieved remarkable success, rivaling or exceeding that of the Co-operative Group. Today, the Mondragon Corporation is a regional cluster of 98 co-operatives spread across the industrial, retail, finance and knowledge industries. In 2017, the Mondragon Corporation generated revenue of more than 12 billion EUR, had devoted 25 million EUR devoted to social action, and employed 80,000 people (Mondragon Corporation 2017b). Some argue that Mondragon innovations developed solutions to some of the major obstacles facing co-operatives, which could be considered adaptations (Whyte and Whyte 1991). For example, the limited worker-to-management pay ratios (which vary between 1:3 and 1:9) appears to build social solidarity (Herrera 2004), and limiting non-owner employees to 10% might help maintain collective ownership in a successful and growing co-operative (Whyte and Whyte 1991).

More recently, Mondragon ideas and practices have spread to other worker co-operatives in England, Pennsylvania (Quigley 2013), California (Arizmendi Association 2016), and the Northeast United States (ICA Group 2017). The International Co-operative Alliance (ICA) facilitated the adoption of certain Mondragon features (Whyte 1995), and the US-based Industrial Cooperative Association, or "ICA Group" adopted and promulgated the Mondragon approach, working Mondragon principles for worker co-operatives into their ICA Model Bylaws, which were used to support the development of worker

co-operatives in the United states (ICA Group 2017). In summary, the co-operative principles were transmitted to Mondragon where they were intentionally modified for longevity and became a founding part of a very successful cluster of worker co-operatives, from which they have been spread again.

New Generation Agricultural Co-operatives.

In the 1990's technological changes and vertical integration in the agriculture industry led to a substantial decrease in the value that farmers received from their crops (Drabenstott 1994). From 1910 to 1990, a farmer's share of their crops dropped from 41 cents on the dollar, to 9 cents. Agricultural producer co-operatives were unable to cope with these changes. Low entrance costs and a lack of enforcement allowed free-riding members to sell their crops elsewhere if the price was higher. Many agricultural co-operatives folded (Birchall 1997).

To combat the these issues and increase the value the received from their crops, farmers in North Dakota and Minnesota started "New Generation" co-operatives (Harris et al. 1996; Merrett and Walzer 2001) which differed from traditional co-operatives in three distinct ways. First, substantial membership dues were instituted with the goals of raising capital and to provide a disincentive to free-riding behavior. Second, the co-operative would only accept a number of fixed amounts of produce from their members called shares, which were accompanied by voting rights. Third, community members were allowed to purchase non-voting shares so that they could purchase produce at a discounted rate. These new practices were not implemented as changes to the co-operative principles, but as supplemental operating procedures (Birchall 1997; Merrett and Walzer 2001).

These new procedures were successful, and member farmer's earnings improved after their implementation (Birchall 1997). Additionally, the new co-operatives brought $2 billion in investment and 5000 jobs to rural areas of North Dakota and Minnesota (Birchall 1997).

Current Distribution.

Co-operatives are widespread today, with over 2.9 million co-operatives worldwide, 1.2 billion members and over 279 million employees (Eum 2017). The top 300 of these co-operatives gross $2.1 trillion USD annually (Bazzana et al. 2017). In 2017, over 39,000 co-operative organizations across the United States employed over 636,000 people (Hueth 2017). The majority of these organizations were in the financial services sector, followed by commercial sales and marketing, and social and public services. Although co-operatives are widespread, no consistent data is available on the present distribution of the co-operative principles. However, an informal survey demonstrates that the principles are at least displayed, promoted, or discussed by co-operatives in the housing, insurance, utilities, food, financial, childcare, purchasing, art & craft, and agriculture industries in the United States covering consumer, worker and producer co-operatives. (See Appendix Table 7 for details.)

Table 5 Evidence of Darwinian Factors among the Co-operative Principles

Principles	Variation	Inheritance	Selection
Principles as a whole	• Early co-operatives had no principles, some principles, or Rochdale principles. • Mondragon intentionally changed some of the Rochdale principles, creating variations. • Few early American co-operatives followed Rochdale's principles. • ICA documented the intention of each change it has made to the principles. • Arizmendi altered the Owen/Rochdale model for labor and for longevity (Whyte 1995). • Differential use of principles (Chambers 1962) • Intentional changes: Disallowing credit, building capital, including non-members (Thompson 1994)	• Rochdale principles were transmitted to many different groups, including Mondragon (Whyte 1995) and CLUSA (Chambers 1962) •Publication of almanacs of rules of practice. • Mondragon ideas spread to other co-operatives, like the Philadelphia Area Co-operative Alliance in the United States, co-operative businesses in England, and the International Co-operative Alliance • Principles expanded to new co-operatives when Pioneers expanded their operation. • CLUSA worked to spread the co-operative economic model, including the co-operative principles. • When pre-existing co--operatives in England came in contact with the Rochdale Pioneers, many adopted the principles. • Originator of Mondragon learned about Rochdale and the principles through his seminary studies (Whyte 1995). • Network organizations such as the ICA disseminate the principles globally with communication technology. • Rochdale principles transmitted to the rest of the Europe and Scandinavia when people with co-operative experience migrated from England. • Later, migrants from Scandinavia brought the principles with them and formed new	• The co-operatives with the Rochdale or Mondragon principles persisted longer. • Autocratically inclined co-operatives eventually suffered bankruptcy, and CLUSA retained Rochdale principles (Parker 1937). • Policy change led to business growth (Thompson 1994) • Use of principles correlates with success for KoL, SoI, PoH (Parker 1956, Parker 1937).

Table 5 (continued)

Principles	Variation	Inheritance	Selection
		co-operatives in the American Midwest (Birchall 1997) • Mondragon ideas spread to US, UK, ICA (Arizmendi Association 2016; ICA Group 2017; Quigley 2013; Whyte 1995) • Dissemination of principles with almanac (Fairbairn 1994)	
1) OPEN: Voluntary and open membership/ Open admission	• "New Generation" had membership dues, only accepted a fixed amount of produce from their members, and community members could purchase at a discounted rate.	• Formation of Cooperative Wholesale Society • New Generation interpretation of open membership that includes membership fees and requirements became codified in the ICA's (2015) principle guidelines, and now membership fees have become pervasive in co-operatives across sectors.	• Membership fees increased cost of defecting in a social dilemma, causing more members to cooperate • Open membership principle caused growth (Fairbairn 1994)
2) DEMO: Democratic member control/ Democratic organization	• Some had "one member one vote" while others had proportional voting.		• co-ops with one member one vote had higher economic performance than those with proportional voting. • In the US, those with democratic management survived longer than those with autocratic structure (Parker 1937) • Dutch co-operatives which employ the one-member one-vote interpretation of democratic control principle appear to have better economic success than co-operatives with share-based voting. These patterns of selection derive from the shared ownership and control of co-operatives and would not be expected among hierarchical organizations. One-member-one-vote

Table 5 (continued)

Principles	Variation	Inheritance	Selection
			rule correlated with profit, growth (Kyriakopoulos et al. 2004)
3) ECON: Member economic participation/ Participatory management			• Many agricultural co-operatives folded from 1910 to 1990, when a farmer's share of their crops dropped from 41 cents on the dollar to 9 cents, probably due to free-riding members, who sold their crops elsewhere if the price was higher. • New Generation procedures were successful, and member farmer's earnings improved after their implementation. • French Wine Co-operatives that return more of their surplus to their members, in accordance with the guidelines to the co-operative principles, have higher success rates (Valette et al. 2018)
4) BTWN: Cooperation among co-operatives/	Inter-cooperation	• Added by ICA in 1966 designed to help build larger co-operative economy.	
5) COMM: Concern for community/ Social transformation, Universality	• Added by ICA in 1995 intended to make co-operatives a driver of economic prosperity, particularly in rural areas.		
6) CASH/ CREDIT	• NO: Rochdale Friendly Cooperative Society • YES, from intentional change: Rochdale Society of Equitable Pioneers • Elimination of cash trading by ICA in 1966 intended to fit the growing trend of		• Rochdale Friendly Cooperative Society did not persist • Rochdale Society of Equitable Pioneers persisted longer, brought increases in revenue, and expanded their business. • Market competition caused selection on

Table 5 (continued)

Principles	Variation	Inheritance	Selection
	effective credit and lending practices.		co-operatives for business-reliant principles, and as the business environment changed, so did the selection for working with credit. • Use of credit (principle) caused failure (Fairbairn 1994)
7) NEUT: Political Neutrality			• Retention of political neutrality may have allowed CLUSA o-ops to survive when groups that embraced Marxism came under attack, but we don't have direct evidence.

Table 6 The Mondragon Principles. The Basic Principles of the MONDRAGON Co-operative Experience were approved at our first Co-operative Congress held in October 1987. They include a set of ideas forged over more than 30 years of operation as a co-operative and are set out below in a condensed version. From https://www.mondragon-corporation.com/en/co-operative-experience/our-principles/

Title	Description
Open admission	The MONDRAGON co-operative experience is open to all men and women who accept these Basic Principles without any type of discrimination.
Democratic organisation	The basic equality of worker-members in terms of their rights to be, possess and know, which implies acceptance of a democratically organised company based on the sovereignty of the General Assembly, electing governing bodies and collaborating with managerial bodies.
Sovereignty of labour	Labour is the main factor for transforming nature, society and human beings themselves. As a result, the systematic recruitment of salaried workers has been abandoned, full sovereignty is attached to labour, the wealth created is distributed in terms of the labour provided and there is a will to extend the job options available to all members of society.
Instrumental and subordinate nature of capital	Capital is considered to be an instrument subordinate to labour, which is necessary for business development. Therefore, it is understood to be worthy of fair and suitable remuneration, which is limited and not directly linked to the profits obtained, and availability subordinate to the continuity and development of the co-operative.
Participatory management	

Table 6 (continued)

Title	Description
	The steady development of self-management and, consequently, of member participation in the area of company management which, in turn, requires the development of adequate mechanisms for participation, transparent information, consultation and negotiation, the application of training plans and internal promotion.
Payment solidarity	Sufficient and fair pay for work as a basic principle of its management, based on the permanent vocation for sufficient collective social promotion in accordance with the real possibilities the co-operative has, and fair on an internal, external and MCC level.
Inter-cooperation	As the specific application of solidarity and as a requirement for business efficiency, the Principle of Inter-cooperation should be evident: between individual co-operatives, between subgroups and between the Mondragon co-operative experience and Basque co-operative organisations, and co-operative movements in Spain, Europe and the rest of the world.
Social transformation	The willingness to ensure fair social transformation with other peoples by being involved in an expansion process that helps towards their economic and social reconstruction and with the construction of a freer, fairer and more caring Basque society.
Universality	Its solidarity with all those who work for economic democracy in the area of the Social Economy by adopting the objectives of Peace, Justice and Development which are inherent to the International Co-operative Movement.
Education	To promote the establishment of the principles stated above, it is essential to set aside sufficient human and financial resources for co-operative, professional and youth education.

Table 7 Informal survey of the prevalence of the co-operative principles across Industries

Industry	Name	Type	URL	Co-operative Notes	Principles Application Notes
Agriculture	Southern States Cooperative	Producer/User	https://www.southernstates.com/cooperative/	11th largest agricultural cooperative in the US $2.107 Billion in Business Volume in 2014, Vast explaination of the benefits and participation minimums on website	Lists principles on the website. Explains how the principles are to be used, what they are, and how they are integrated into the structure of the organization. To join, you must be a producer of ag products to the market. - Strictly use one member one vote.
	Agtegra	Producer/User	https://www.agtegra.com/About#history	Help Supply fuel, agricultural tech, and help with the distribution of grain supplies	Principles are not Listed on the website. Bylaws were surveyed for evidence of Principles. - Voluntary & Open Membership (Open to all patron producers, Article 1 Section 1; Withdrawal is available to any-one for any reason, A1 Sec 3) - Democratic Member Participation - (one member one Vote, Article 1, Section 7) - Member Economic Participation (Eligibility only comes after a producer does $5000 or more of business. - Autonomy & Independence (Exclusively member owned, and can only be owned by producers, A1 S1 A5 S1&2) - Education (Offer many different agricultural services and technology training to members.
Art & Craft	Colab cooperative	Worker	https://colab.coop/	Designs and Develops Websites Based out of Ithaca NY, Worked with the ICA	List the Co-operative Principles on their website
Purchasing	National Cooperative Rx	User	http://www.nationalcooperativerx.com/	Pharmaceutical purchasing co-operative centered around pooling resources to purchase medicine for employers and organizations	List the Co-operative Principles on their website
Child Care	Energy Capital Cooperative Child Care	User	https://energycapitalcooperative.com/	Child Care school for infants - 12 years of age	Has a link to the principles on their Overview Page
Credit Unions	CO-OP		https://co-opcreditunions.org/		Have a blog about the principles.

Table 7 (continued)

Industry	Name	Type	URL	Co-operative Notes	Principles Application Notes
		Coop of Coops		connection of credit unions that offer shared branching.	Co-op among coops (Shared Branching)
	OTIS Federal Credit Union	User	https://www.otisfcu.coop/	Federal Credit Union, $159 Million in assets	Has a page devoted to the coop principles
Food Coop	NCGA	Cooperative Association	https://www.ncg.coop/	association that assists and networks co-operatives	
Web page devoted to the principles					
Housing	NAHC - National Association of Housing Cooperatives	Cooperative Association	https://coophousing.org/	National association that is affiliated with the ICA that provides resources and education for housing co-operatives across the United States	
Web page devoted to the principles					
Insurance	the co-operators	coop of coops	https://www.cooperators.ca/en/About-Us.aspx	Insurance and financial services co-operative, works in property and casualty insurance, life insurance, and institutional investments.	Web page that details how they follow the co-op principles and advocates for the co-operative advantage.
Student	Berkely Student Cooperative	Worker/User Owned	https://www.bsc.coop/index.php	co-operative housing unit that provides both food and housing to students and provides them with jobs	Have an older version of the principles with a link to the ICA website for the newer ones as well
Energy & Utility	America's Electric Cooperatives	Cooperative Service Organization	https://www.electric.coop/	Offer services and advocacy for electricity co-operatives and co-operatives in general	
Co-op 101 posting on December 1, 2016 about the 7 principles					

Code availability No code to provide.

Author contributions TW & TL co-conceptualized the article; TL, TW & SC conducted historical research and analyses; TW, TL, & SC wrote the manuscript.

Funding This work was supported by NSF CAREER Grant # SES-1352361.

Data availability No data or materials to provide.

Declarations

Conflict of interest The authors declare no conflicting interests.

References

Arizmendi Association, 2016. Arizmendi Association [WWW Document]. URL http://arizmendi.coop/ (accessed 1.9.19)

Axelrod R, Hamilton WD (1981) The evolution of cooperation. Science 3(211):1390–1396

Bazzana F, Catturani I, Berton A, Gotz I, Carini C, Turri S (2017) World co-operative monitor: exploring the co-operative economy (no. 6). International cooperative Alliance

Benos T, Kalogeras N, Verhees FJHM, Sergaki P, Pennings JME (2016) Cooperatives' organizational restructuring, strategic attributes, and performance: the case of agribusiness cooperatives in Greece. Agribusiness 32:127–150. https://doi.org/10.1002/agr.21429

Bikhchandani S, Hirshleifer D, Welch I (1992) A theory of fads, fashion, custom, and cultural change as informational cascades. J Polit Econ 100:992–1026

Birchall, J., 2012. A "member-owned business" approach to the classification of co-operatives and Mutuals, in: McDonnell, D., Macknight, E. (Eds.), The Co-Operative Model in Practice: International Perspectives. pp. 4–15

Birchall J (1997) The international co-operative movement. Manchester University Press

Boyd, R., 2016. Cultural adaptation and maladaptation: of kayaks and commissars, in: Gangestad, S.W., Simpson, J.a. (Eds.), the evolution of mind: fundamental questions and controversies. Guilford publications, pp. 337–331

Boyd R, Richerson PJ (1985) Culture and the evolutionary process. University of Chicago Press, Chicago

Cadot J (2015) Agency costs of vertical integration—the case of family firms, investor-owned firms and cooperatives in the French wine industry. Agric Econ 46:187–194. https://doi.org/10.1111/agec.12150

Calhoun C (1993) "New social movements" of the early nineteenth century. Soc Sci Hist 17:385–427. https://doi.org/10.2307/1171431

Cavalli-Sforza, L.L., Feldman, M.W., 1981. Cultural transmission and evolution: a quantitative approach, monographs in population biology vol. 16. Princeton University press, Princeton, NJ

Chaddad F, Iliopoulos C (2013) Control rights, governance, and the costs of ownership in agricultural cooperatives. Agribusiness 29:3–22. https://doi.org/10.1002/agr.21328

Chambers CA (1962) The cooperative league of the United States of America, 1916-1961: a study of social theory and social action. Agric Hist 36:59–81

Clare, Gupta (2014) The co-operative model as a 'living experiment in democracy'. Journal of Co-operative Organization and Management 2(2) 98-107 https://doi.org/10.1016/j.jcom.2014.09.002

Collard M, Tehrani J (2005) Cladistic analysis of Turkmen textiles sheds light on cultural evolution. In: Mace R, Holden C, Shennan SJ (eds) The evolution of cultural diversity: a phylogenetic approach. University College London Press, London, pp 107–131

Co-op Group, 2017. Co-op annual report 2017 (annual report)

Craig B, Pencavel J (1992) The behavior of worker cooperatives: the plywood companies of the Pacific northwest. Am Econ Rev 82:1083–1105

Curry OS (2016) Morality as cooperation: a problem-Centred approach. In: Shackelford TK, Hansen RD (eds) The evolution of morality. Evolutionary Psychology. Springer International Publishing, Cham, pp 27–51. https://doi.org/10.1007/978-3-319-19671-8_2

Darwin, C., 1859. On the origin of species by natural selection. Murray Lond. U. K.
Davidovic G, Cooperative Union of Canada (1966) Reformulation of the co-operative principles: a commentary on the guiding principles of co-operative organisations, with an analysis of Canadian views on the Rochdale principles. Co-operative Union of Canada, Ottawa
David Sloan, Wilson Elinor, Ostrom Michael E., Cox (2013) Generalizing the core design principles for the efficacy of groups. Journal of Economic Behavior & Organization 90S21-S32 https://doi.org/10.1016/j.jebo.2012.12.010
Desroche, H., 1971. Images and echoes of Owenism in Ninteenth-century France, in: pollard, S., salt, J. (Eds.), Robert Owen, prophet of the poor: essays in honour of the two hundredth anniversary of his birth. Bucknell University press, pp. 239-
Drabenstott, M., 1994. Industrialization: steady current or tidal wave? Choices 09
Eum, H., 2017. Cooperatives and employment second global report 2017: contribution of cooperatives to decent work in the changing world of work (no. 2), cooperatives and employment. International Organization of Industrial and Service Cooperatives
Fairbairn, B., 1994. The meaning of Rochdale: the Rochdale pioneers and the co-operative principles (no. 31778), Occasional Papers. University of Saskatchewan, Centre for the Study of Co-operatives
Ferreira, M., Macagnan, C., Vancin, D., Toaldo, A., 2020. Technical assistance: a determinant of cooperative member loyalty. Ann Public Coop Econ n/a doi: https://doi.org/10.1111/apce.12312
Figueiredo V, Franco M (2018) Factors influencing cooperator satisfaction: a study applied to wine cooperatives in Portugal. J Clean Prod 191:15–25. https://doi.org/10.1016/j.jclepro.2018.04.177
Fulton ME (1990) Individual and collective interests in co-operatives. In: Organizations C-O, Society C (eds) Popular institutions and the dilemmas of change. University of Toronto Press, Toronto, pp 103–114
Gangestad SW, Haselton MG, Buss DM (2006) Evolutionary foundations of cultural variation: evoked culture and mate preferences. Psychol Inq 17:75–95
Giot P, Schwienbacher A (2007) IPOs, trade sales and liquidations: modelling venture capital exits using survival analysis. J Bank Finance 31:679–702. https://doi.org/10.1016/j.jbankfin.2006.06.010
Godfrey-Smith P (2001) Three kinds of adaptationism. In: Sober E, Orzack SH (eds) Adaptationism and optimality. Cambridge University Press, Cambridge, pp 335–357
Grashuis J (2020a) Agricultural firm survival: the case of farmer cooperatives in the United States. Agribusiness 36:79–93. https://doi.org/10.1002/agr.21612
Grashuis J, Cook M (2018) An examination of new generation cooperatives in the upper Midwest: successes, failures, and limitations. Ann. Public Coop. Econ. 89:623–644. https://doi.org/10.1111/apce.12211
Grashuis J, Dary SK (2021) Design principles of common property institutions: the case of farmer cooperatives in the upper west region of Ghana. Int J Commons 15:50–62. https://doi.org/10.5334/ijc.1056
Grashuis J, Su Y (2019) A review of the empirical literature on farmer cooperatives: performance, ownership and governance, finance, and member attitude. Ann. Public Coop. Econ. 90:77–102. https://doi.org/10.1111/apce.12205
Gray, T.W., Kraenzle, C.A., 1998. Member participation in agricultural cooperatives : a regression and scale analysis (RBS research report no. 165). United States Department of Agriculture, rural development, rural business cooperative service, Washington, D.C.
Gupta C (2014) The co-operative model as a 'living experiment in democracy'. J Co-oper Organ Manag 2(2): 98–107. https://doi.org/10.1016/j.jcom.2014.09.002
Guzmán C, Santos FJ, de la Barroso MO (2020) Analysing the links between cooperative principles, entrepreneurial orientation and performance. Small Bus Econ 55:1075–1089. https://doi.org/10.1007/s11187-019-00174-5
Hanes SP, Waring TM (2018) Cultural evolution and US agricultural institutions: a historical case study of Maine's blueberry industry. Sustain Sci 1–10. https://doi.org/10.1007/s11625-017-0508-3
Hannan MT, Freeman J (1993) Organizational ecology. Harvard University Press
Hansmann H (1988) Ownership of the firm. J Law Econ Organ 4:267–304
Harris A, Stefanson B, Fulton M (1996) New generation cooperatives and cooperative theory. J Coop 11:15–28
Henrich J (2015) The secret of our success: how culture is driving human evolution, domesticating our species, and making us smarter. Princeton University Press
Henrich J (2004) Cultural group selection, coevolutionary processes and large-scale cooperation. J Econ Behav Organ 53:3–35. https://doi.org/10.1016/S0167-2681(03)00094-5
Henrich J, Ensminger J, McElreath R, Barr A, Barrett C, Bolyanatz A, Cardenas JC, Gurven M, Gwako E, Henrich N, others (2010) Markets, religion, community size and the evolution of fairness and punishment. Science 327:1480–1484

Henrich J, Henrich N (2010) The evolution of cultural adaptations: Fijian food taboos protect against dangerous marine toxins. Proc R Soc Lond B Biol Sci 277:3715–3724. https://doi.org/10.1098/rspb.2010.1191
Herrera, D., 2004. Mondragon: a for-profit organization that embodies Catholic social thought. Rev. bus. 25, 56-
Hetherington, J.A.C., 1991. Mutual and cooperative enterprises: an analysis of customer-owned firms in the United States. Univ of Virginia Pr, Charlottesville
Hilson M (2013) Consumer Co-operation and Economic Crisis: The 1936 Roosevelt Inquiry on Co-operative Enterprise and the Emergence of the Nordic 'Middle Way'. Contemp Eur Hist 22:181–198. https://doi.org/10.1017/S0960777313000040
Hodgson GM (2019) Taxonomic definitions in social science, with firms, markets and institutions as case studies. J Institutional Econ 15:207–233. https://doi.org/10.1017/S1744137418000334
Hodgson, G.M., Knudsen, T., 2010. Darwin's Conjecture: The Search for General Principles of Social and Economic Evolution. University Of Chicago Press, Chicago ; London
Hueth, B., 2017. The state of the co-op economy. Coop. Bus. J ICA, 2015. Guidance Notes to the Co-operative Principles
ICA (1966) Report of the 23rd international co-operative Alliance congress at Vienna, 5–8 September, 1966. Internaional Co-operative Information Centre, Vienna
ICA Group, 2017. ICA Group history [WWW document]. ICA Group Hist. URL https://ica-group.org/ica-group-history/ (accessed 1.9.19)
Iliopoulos C, Theodorakopoulou I (2014) Mandatory cooperatives and the free rider problem: the case of Santo wines in Santorini. Greece Ann Public Coop Econ 85:663–681. https://doi.org/10.1111/apce.12056
International Cooperative Alliance, 2015. Guidance Notes to the Co-Operative Principles
Iwasaki I, Kočenda E (2020) Survival of service firms in European emerging economies. Appl Econ Lett 27: 340–348. https://doi.org/10.1080/13504851.2019.1616053
Jelsma I, Slingerland M, Giller KE, Bijman J (2017) Collective action in a smallholder oil palm production system in Indonesia: the key to sustainable and inclusive smallholder palm oil? J Rural Stud 54:198–210. https://doi.org/10.1016/j.jrurstud.2017.06.005
Kleanthous AS (2017) Co-operatives, credit unions and principles: a post 2008 critique (PhD). University of Glasgow
Kline, M.A., Waring, T.M., Salerno, J., 2017. Designing cultural multilevel selection research for sustainability science. Sustain Sci 1–11. doi: https://doi.org/10.1007/s11625-017-0509-2
Kyriakopoulos K, Meulenberg M, Nilsson J (2004) The impact of cooperative structure and firm culture on market orientation and performance. Agribusiness 20:379–396. https://doi.org/10.1002/agr.20021
Lansing JS, Cox MP (2011) The domain of the replicators. Curr Anthropol 52:105–125. https://doi.org/10.1086/657643
Laurett R, Franco M (2018) Cooperation process: what motivates individuals to participate in a cooperative? Int J Manag Pract 11:93–110
Ménard C (2007) Cooperatives: hierarchies or hybrids? In: Karantininis K, Nilsson J (eds) Vertical markets and cooperative hierarchies: the role of cooperatives in the Agri-food industry. Springer Netherlands, Dordrecht, pp 1–18. https://doi.org/10.1007/1-4020-5543-0_1
Merrett CD, Walzer N (2001) A survey of new generation cooperatives: exploring alternative forms of rural economic development. In: Merrett CD, Walzer N (eds) A cooperative approach to local economic development. Quorum Books, Westport, Connecticut, pp 91–115
Mesoudi A (2017) Pursuing Darwin's curious parallel: prospects for a science of cultural evolution. Proc Natl Acad Sci 114:7853–7860. https://doi.org/10.1073/pnas.1620741114
Mesoudi A, Whiten A, Laland KN (2004) Perspective: is human cultural evolution Darwinian? Evidence reviewed from the perspective of the origin of species. Evolution 58:1–11. https://doi.org/10.1111/j.0014-3820.2004.tb01568.x
Mondragon Corporation, 2017a. Our principles. URL https://www.mondragon-corporation.com/en/co-operative-experience/our-principles/ (accessed 11.8.18)
Mondragon Corporation, 2017b. MONDRAGON Corporation, annual report, 2017. URL https://www.mondragon-corporation.com/en/about-us/economic-and-financial-indicators/annual-report/ (accessed 11.8.18)
Nilsson J (2001) Organisational principles for co-operative firms. Scand J Manag 17:329–356. https://doi.org/10.1016/S0956-5221(01)00010-0
Nilsson L, Hansson H, Lagerkvist CJ (2017) Motivational factors for remaining in or exiting a cooperative. Agribusiness 33:209–225. https://doi.org/10.1002/agr.21480
Norenzayan A, Shariff AF (2008) The origin and evolution of religious Prosociality. Science 322:58–62. https://doi.org/10.1126/science.1158757
Novkovic S (2008) Defining the co-operative difference. J. Socio-Econ. Special Issue: Cooperatives and the Economy 37:2168–2177. https://doi.org/10.1016/j.socec.2008.02.009

Oczkowski E, Krivokapic-Skoko B, Plummer K (2013) The meaning, importance and practice of the co-operative principles: qualitative evidence from the Australian co-operative sector. J Co-op Organ Manag 1:54–63. https://doi.org/10.1016/j.jcom.2013.10.006

Ostrom E (1990) Governing the commons. Cambridge University Press

Parker, F.E., 1956. The first 125 years :a history of distributive and service cooperation in the United States, 1829–1954 /. Cooperative Publishing Association, Superior, Wisconsin

Parker FE (1937) Consumers' Coöperation in the United States. Ann Am Acad Pol Soc Sci 191:91–102. https://doi.org/10.1177/000271623719100113

Pozzobon DM, Zylbersztajn D (2013) Democratic costs in member-controlled Organizations. Agribusiness 29:112–132. https://doi.org/10.1002/agr.21324

Puusa A, Hokkila K, Varis A (2016) Individuality vs. communality: a new dual role of co-operatives? J. Co-op. Organ. Manag. 4:22–30. https://doi.org/10.1016/j.jcom.2016.02.002

Quigley, C., 2013. Creating a cooperative culture: lessons from Mondragón. URL https://philadelphia.coop/mondragon2013/ (accessed 11.13.18)

Rand DG (2016) Cooperation, fast and slow: meta-analytic evidence for a theory of social heuristics and self-interested deliberation. Psychol Sci 27:1192–1206. https://doi.org/10.1177/0956797616654455

Richerson P, Baldini R, Bell AV, Demps K, Frost K, Hillis V, Mathew S, Newton EK, Naar N, Newson L, Ross C, Smaldino PE, Waring TM, Zefferman M (2016) Cultural group selection plays an essential role in explaining human cooperation: a sketch of the evidence. Behav Brain Sci 39:e30 (19 pages). https://doi.org/10.1017/S0140525X1400106X

Sperber, D., 1996. Explaining culture: a naturalistic approach. Camb. MA Camb

Tavassoli S, Jienwatcharamongkhol V (2016) Survival of entrepreneurial firms: the role of agglomeration externalities. Entrep Reg Dev 28:746–767. https://doi.org/10.1080/08985626.2016.1247916

Tehrani JJ (2013) The phylogeny of little red riding Hood. PLoS One 8:e78871. https://doi.org/10.1371/journal.pone.0078871

Thompson, D.J., 1994. Weavers of dreams: the origins of the modern co-operative movement. Center for Cooperatives, University of California

Tschopp M, Bieri S, Rist S (2018) Quinoa and production rules: how are cooperatives contributing to governance of natural resources? Int J Commons 12:402–427

Turchin, P., 2007. War and peace and war: the rise and fall of empires. Plume

UN, 2014. Measuring the size and scope of the cooperative economy: results of the 2014 global census on co-operatives (David grace and associates). United Nation's Secretariat Department of Economic and Social Affairs Division for Social Policy and Development

USDA, 1999. Cooperatives help farmers survive the great depression, Position Themselves for New Marketing Opportunities Rural Coop 66

Valette J, Amadieu P, Sentis P (2018) Cooperatives versus corporations: survival in the French wine industry. J Wine Econ 13:328–354. https://doi.org/10.1017/jwe.2017.1

van Oorschot K, de Hoog J, van der Steen M, van Twist M (2013) The three pillars of the co-operative. J. Co-op. Organ. Manag. 1:64–69. https://doi.org/10.1016/j.jcom.2013.10.002

Waring T, Acheson J (2018) Evidence of cultural group selection in territorial lobstering in Maine. Sustain Sci 13:21–34. https://doi.org/10.1007/s11625-017-0501-x

Waring TM, Goff SH, Smaldino PE (2017) The coevolution of economic institutions and sustainable consumption via cultural group selection. Ecol Econ 131:524–532. https://doi.org/10.1016/j.ecolecon.2016.09.022

Whyte WF (1995) Learning from the Mondragon cooperative experience. Stud Comp Int Dev 30:58

Whyte WF, Whyte KK (1991) Making Mondragón: the growth and dynamics of the worker cooperative complex. Cornell University Press

Wilson DS, Ostrom E, Cox MJ (2013) Generalizing the core design principles for the efficacy of groups. J Econ Behav Organ 90S21–S32. https://doi.org/10.1016/j.jebo.2012.12.010

Youngblood, M., Baraghith, K., Savage, P.E., 2020. Phylogenetic reconstruction of the cultural evolution of electronic music via dynamic community detection (1975-1999). ArXiv201102460 Q-bio stat