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Market mashups: The process of combinatorial market innovation

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Abstract

This paper investigates market innovation that takes place at the intersection of previously weakly connected markets. Based on a longitudinal study of the development of the digital therapeutics market, we delineate the concept of *combinatorial market innovation* as a market innovation process that is characterized by the deliberate synthesis of market subprocesses from two (or more) existing markets. We develop a conceptualization of combinatorial market innovation related to five market subprocesses (configuring exchange agents, qualifying offerings, fashioning modes of exchange, generating market representations, and establishing market norms). Focusing on how these processes interact, we identify three distinct types of intertwinement – *sequential interrelation, mutual reinforcement*, and *interference*. We also reflect on the need for market innovation studies to more strongly consider overlaps and adjacencies between markets and market systems.

**Keywords**: market system, market innovation, hybridity, combinatorial innovation, digital therapeutics, digital health.
1. Innovating at market intersections

How is market innovation carried out at the intersection of two (or more) already existing markets? This question has become highly relevant for firms in an era where previously separate product markets more frequently converge and where this convergence may give rise to ‘hybrid’ markets. By combining elements from different markets, innovators may seek to change one of these markets or create a new market that is only loosely connected to its origins. In this paper, we focus on situations in which market innovators strategically combine and retain aspects of more than one ‘parent’ market in their market innovation efforts. We argue that such combinatorial market innovation is increasingly common in a world of modular processes and market intersections, and that both conceptual and empirical work is needed to explain such processes and assist managers in coping with them.

Over the past two decades, a growing body of research has shown markets to be significantly influenced by active agents seeking to push them in certain directions (see Sprong et al. 2021 for a recent overview). Taken together, this research offers a forceful argument for changing the view of markets from that of static backdrops to firm activity to that of dynamic entities central to firms’ strategic efforts (Jaworski et al. 2000; Nenonen et al. 2019; Storbacka and Nenonen 2011). While this literature recognizes that markets continuously develop and change and that these processes can be strategically acted on, it often fails to nuance differences and commonalities between market innovation processes. For instance, researchers conflate processes where actors aim to create markets that are ‘new to the world’ and processes of market change along specific dimensions (Rosa et al. 1999). Previous research also tends to treat the formation and change of individual product markets in isolation (Mele et al. 2015). Only a few studies focus on the interdependencies and reverberating effects of market change beyond singular product markets (e.g. Kjellberg and Olson 2017). Yet, innovation at the intersection of several markets has become highly relevant in an era where digitalization brings previously
independent product markets in closer contact (Yoo et al. 2012). The autonomous vehicle (AV) market, for instance, combines product forms from the car market with data infrastructures and artificial intelligence from ICT markets. As this combination reverberates across all market subprocesses it arguably yields a ‘new’ market rather than simply a market change: It engenders a new market object (the artificially intelligent self-driving car); it requires extensive institutional, behavioral and infrastructural changes (adapting century-old road regulations, relearning what ‘driving a car’ entails, ensuring fully stable and secure WiFi connections); it necessitates the formation of a network among previously unconnected market stakeholders (e.g. the cooperation between Google’s Waymo division and car manufacturer Jaguar), and it prompts the creation of new, ‘born hybrid’ actors (start-ups such as Aurora and Zoox). Markets such as the AV market thus develop at the intersection of two existing markets, retain pertinent features of both ‘parent’ markets, but contain enough changes across all market subprocesses that the resulting market is considered and/or represented as ‘new’ by involved market actors.

The purpose of this article, then, is to develop a conceptualization of market innovation processes at the intersection of two (or more) existing markets. To this end, we combine previous insights on market innovation with a longitudinal case study on digital therapeutics and develop the concept of *combinatorial market innovation* as a type of market innovation process with pronounced hybrid characteristics. While some scholars argue that all innovation is combinatorial (Arthur 2009; Wagner and Rosen, 2014), Yoo et al. (2012, p. 1402) diagnosed combinatorial innovation as a pervasive consequence of digitalization, where modular designs are often creatively blended without designers “fully knowing the ‘whole’ design of how each module will be integrated with another”. We extend their argument from technology to markets

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1 In this paper, we adopt the emic stance typical of constructivist market studies, leaving it to “the actors under study to define the building blocks constituting reality” including what does or does not constitute a new or changed market (Kjellberg and Helgesson 2006: 841; Latour 2005).
and define combinatorial market innovation as the deliberate and thoughtful combination of elements from two or more existing markets to generate a new market. This, we argue, requires a distinct strategic emphasis of market innovators. Specifically, combinatorial market innovation brings together the novelty and creative aspects of market creation with the need to work with well-established market arrangements from market change processes. Since these established arrangements emanate from more than one market, combinatorial market innovators are likely to simultaneously have ‘too few’ and ‘too many’ legacy elements to work with – hence the need for a strategic and reflective approach on what to combine and how.

To delineate the character of combinatorial market innovation, we present a longitudinal case study of the development of the market for “digital therapeutics”. In recent years, shifting demographic profiles, cost explosions and advances in sensor technologies have led to an increasing number of overlaps between the ICT and healthcare fields (Geiger and Gross 2017; Kraus et al. 2021). In one of these overlaps - digital therapeutics - market innovators have endeavored to establish technologies and supporting processes that will not simply complement and improve existing market offerings but represent innovative solutions and alternatives to existing cures in and of themselves. Our inquiry into this market innovation process is based on depth interviews, participant observation and documentary analysis.

Based on our analysis we make three contributions to the literature on market innovation. First, we offer a detailed and empirically supported description of combinatorial market innovation as a type of market innovation that draws upon and plays out at the intersection of different markets. Second, we further elaborate the process model proposed by Harrison and Kjellberg (2016) by identifying three basic types of intertwinement – *sequential interrelation, mutual reinforcement*, and *interference* – between subprocesses of market innovation, which we argue helps researchers grasp the systemic nature of markets and their dynamics better. Third, and most importantly, we take the first step in a research program on market innovation at the
intersections and overlaps between markets. We thus extend insights both on the systemic and the combinatorial characteristics of market innovation.

2. Conceptualizing market innovation

2.1 Combination and hybridity in (market) innovation

Market innovation has been defined as “market actors reconfigure[ing] the interfaces, practices or social and material arrangements in and through which market exchanges take place” (Geiger and Gross 2018, p. 1357; see also Kjellberg, Azimont and Reid 2015). Previous research has emphasized the systemic character of market innovation, suggesting that a specific change in a market is likely to occasion other changes in that market as well (Harrison and Kjellberg 2016). We fully support this systemic view; we claim, however, that it has in the main neglected an important perspective: that markets are not closed systems, but that overlaps, intersections and ‘interferences’ between different markets are a likely and frequent occurrence. In fact, scholars from fields as diverse as technology innovation and biology agree that all innovation processes are to a varying extent combinatorial in character, where newness and change result from (re-)combination of previously existing elements drawn from a variety of sources (Arthur 2009; Wagner and Rosen 2014). Recombination may be accidental, due to path dependencies or historical contingencies, or the result of a deliberate drawing together of elements from adjacent or distal places. The outcome of such recombination may appear radically new even though its component elements are not (Carignani, Cattani and Zaina 2019).

In organization studies, the best-known cases of deliberate recombination efforts are so-called hybrid organizations, which combine different “institutional logics in unprecedented ways” (Battilana and Dorado 2010, p. 1419). Studies on hybrid organizations have documented the many tensions and difficulties associated with building and sustaining hybridity, and have also
noted different ‘degrees’ of hybridity (Mair, Mayer and Lutz, 2015). Similarly, the traces of different markets in a ‘new’ market may be more or less visible and pronounced. For instance, Ertimur and Coskuner-Balli (2015) showed how the norms of the yoga market grew out of a combination of spiritual, medical, fitness, and commercial logics, while Kjellberg and Olson (2017) demonstrated that market innovators drew inspiration and combined features from a range of existing markets in the formation of legal cannabis markets in the US. Hybridity may pervade all subprocesses of an organization or market or affect only one or two. In the latter vein, Araujo and Kjellberg (2015) showed how American Airlines altered the qualification of air travel by combining otherwise empty seats with the coupon program idea from US grocery retailing to create their hugely successful Frequent Flyer Program innovation. In other cases, the combinatorial effort may extend to all elements of the market such that the resulting market is truly hybrid: situated at the intersection of two markets and bearing recognizable traces of those. This is arguably the case in the AV market that we mentioned above.

Recombination entails particular kinds of uncertainties: while specific elements may traverse to new contexts, this always involves mutation and translation (Czarniawska and Sévon, 1996). Hence, the more elements are combined, and the more these are truly ‘hybrid’, the more uncertainties arise for the combinatorial market innovator. These are the cases of focal interest in this paper: we argue that studying the deliberate combination of two parent markets into an evidently hybrid market can help us understand, detect and explain hybridity in other, less clear cases of combinatorial market innovation as well.

### 2.2 Markets and their subprocesses

In order to answer the question of how market innovators go about recombining markets, we require a framework that allows us to drill into the details of what is being (re)combined, and how. Thus, to account for the systemic character of markets and in keeping with a constructivist perspective, we employ a market process model that offers a comprehensive categorization of
market subprocesses. Harrison and Kjellberg (2016) suggest that market innovation concerns changes enacted through any of five interrelated subprocesses: (1) configuring exchange agents; (2) qualifying offerings (exchange objects); (3) fashioning modes of exchange; (4) establishing market norms; and (5) generating market representations. As the literature summarized in Table 1 indicates, these subprocesses recur in other conceptualizations of markets as well as in empirical accounts of how markets develop and change (although the specific terms vary). Below, we briefly describe the five subprocesses as per Harrison and Kjellberg (2016) and suggest potential issues arising when market innovation has a pronounced combinatorial character.

====TABLE 1 ABOUT HERE====

*Configuring exchange agents.* Markets develop through mundane and strategic (inter)actions by a diverse range of market actors (Geiger and Finch 2009; Jaworski et al. 2000; Ghaffari et al. 2019; Mountford 2019). While these actors drive market development to different degrees and with different levels of intent, their ability to do so is itself a result of how they are equipped (Andersson et al. 2008; Cochoy 2008; Hagberg 2016). This allows market innovators to increase or decrease the agency of specific others (Araujo and Kjellberg 2015), for instance equip them to handle new situations or circumscribe their actions by providing templates or scripts to which they must adhere.

In cases of combinatorial market innovation, configuring exchange agents involves at least two groups of actors originating from different markets, equipped with different scripts and with different agential capacities. A core question for the innovator, then, is how they can develop their own specific agencies between the two groups of incumbents without provoking too much resistance. Market innovators may also need to consider how to combine different and potentially incompatible actor scripts at the intersection of the two markets.
Qualifying offerings. The qualification and stabilization of new offerings is central to market innovation and includes establishing new product/service categories, altering standards for assessing established offerings, and improving performance according to existing standards (Callon et al. 2002; Rosa et al. 1999). The resulting changes in market offerings alter the competitive landscape, which in turn tends to produce various forms of contestations (Finch and Geiger 2011; Giesler 2008).

Altering markets by developing modified offerings is often seen as a standard strategy for market innovation (Nenonen et al. 2019). Yet, the combination of characteristics or qualification criteria from several markets is likely to require considerably more effort to balance qualifications, resolve tensions between conflicting qualifications, and establish what is seen as valuable by diverse actors. Open questions pertain to how market innovators go about developing the combined offering and what value registers they promote for assessing its value.

Fashioning modes of exchange. Over time, market actors develop behavioral patterns of exchange whose enactment continuously reproduces the market (Callon 1998a). Some such practices are directly linked to the consummation of market exchange and produce specific modes of exchange (Kjellberg and Helgesson 2007), others concern product use, which also influences market development (Shove and Araujo 2010; Stigzelius et al. 2018). Modes of exchange depend on the creation of a transactional infrastructure – material devices that directly affect market behavior. Manipulating these infrastructures, often invisible to market actors, can require a great deal of effort and coordination but can also be a very potent way of innovating markets (Doganova and Karnoe 2015; Kjellberg et al 2019; Mellet and Beauvisage 2020).

In combinatorial market innovation, modes and infrastructures of exchange are likely to be stabilized in each market but not aligned across markets. Key issues thus include: How can differences in the modus operandi of each market be overcome? What interaction effects arise when exchange practices intersect? Which exchange infrastructure should be utilized?
Generating market representations. Markets are abstract entities whose development requires the production of representations that bring together information about actors, offerings, and/or specific exchanges in a standardized format (Anand and Peterson 2000). Several strands of research have stressed the formative role of such representations, for instance as categories and schemas (Bingham and Kahl 2013). Market representations are performative (Callon 1998b); they contribute to bringing about the realities they set out to describe. Thus, future-oriented images/visions of how a market is likely to develop serve as important sources of market change (Geiger and Finch 2016; Geiger and Gross 2017).

For combinatorial market innovators, a likely challenge will be that existing market information regimes only produce partial images of the intersection of the markets and that they may not be compatible in the first place. Thus, how do actors build hybrid categories or schemas and how do they influence, circulate and control market representations in hybrid markets?

Establishing market norms. Markets are enabled and governed by “humanly devised constraints” (North 1991), including formal rules issued by government authorities, regulatory bodies, and voluntary associations, as well as informal norms that legitimate and facilitate market interactions (Finch, Geiger and Reid 2017; Humphreys 2010). This is a highly political subprocess given its focus on the values that guide market actors (cf. Fligstein 1996). Consequently, the successful introduction and dissemination of new norms is a powerful way of influencing the workings of a market (Kjellberg and Helgesson 2010).

With market norms adjusted to each market but potentially clashing, this subprocess is likely to cause considerable work for combinatorial market innovators and likely contestation on the part of other actors. Established regulatory forums may exist within but not across markets. In addition, incumbents from the two markets may attempt to influence regulatory discussions and other normative issues regarding the emerging ‘hybrid’ market. Thus, the challenge will be to
ascertain how a normative scaffolding for the new market can be built without being overpowered by any one of the two sets of incumbents.

2.3 Identified research gaps

To summarize this conceptual discussion, the model proposed by Harrison and Kjellberg (2016) and elaborated above offers a general characterization of the subprocesses that contribute to market development. As such it also indicates possible foci for market innovators and a way of empirically mapping innovation processes. However, as we showed in the previous section, there is a lack of empirical evidence concerning how these processes unfold when market innovators seek to deliberately combine and retain elements from already existing markets. A second issue that requires further elaboration is the characterization of the subprocesses in the model as “intertwined”, particularly in cases where market innovation concerns all five subprocesses. Harrison and Kjellberg (2016, 451) posit that three subprocesses (qualifying exchange objects, fashioning modes of exchange and configuring exchange agents) are more closely intertwined since they all directly concern how economic exchanges are realized, whereas they describe the remaining two subprocesses (generating market representations and establishing market norms) as “complementary”. Beyond this general characterization they do not theorize how the subprocesses intertwine. Similarly, in their identification of capabilities for market shaping, Nenonen et al (2019) suggest that three distinct capabilities contribute to re-designing exchange but do not elaborate on how they interrelate. There is thus scope for increased conceptual precision concerning how market innovation in one subprocess amplifies or interferes with work on other subprocesses. This, we argue, is particularly important in combinatorial market innovation, which requires the careful weaving together of separate market processes into a coherent whole.
3. Methodology

3.1 Empirical approach

Our choice of a longitudinal case study was driven by conceptual interest in market dynamics and market innovation at the intersection of existing markets. Since our review of the literature suggested that existing research could not fully explain what happened at these intersections, we searched for exemplar cases of hybrid markets across the business press and in conversation with practitioners. In this search, the healthcare sector emerged as a prime candidate since the possibility of using digital technologies to meet increasing demand had produced a growing number of links between the life sciences, healthcare and information and communication technology (ICT). One of these linkages is the market for “digital therapeutics”, which recombines elements from the heavily regulated pharmaceutical market and the fast-paced and consumer-centric ICT market (hereafter ‘tech’). In this new market, digital technologies do not simply serve as delivery devices; rather, digital features are merged with medical ones to form completely new offerings. This novelty is formally recognized by regulators and other market actors.\textsuperscript{1,2} Section 3.3 introduces this empirical setting in greater detail.

Having identified digital therapeutics as an exemplary site to develop our understanding of combinatorial market innovation, we embarked on a multi-sited and multi-method exploratory study into the formation of the digital therapeutics market. We undertook empirical research from 2015 to 2018 but retrospective interviewing and archival material allow us to cover the development from the late 2000s. The fieldwork included participant observation at 20 industry events in the USA and Europe, including conferences, meet-ups, industry showcases and academic workshops. Five heavily subscribed US-based and one UK-based digital health email

\textsuperscript{a} We conducted a manual, in-depth review of the literatures in the following areas: market studies (including market innovation), institutional approaches to markets, market driving, and the sociology of markets across a wide range of academic journals.
newsletters and other internet sources provided general information about the digital therapeutics market and the activities of firms therein. We conducted 30 depth interviews with entrepreneurs, healthcare and technology stakeholders, government and regulators, industry consultants, and conference organizers. We chose research participants based on their prominence in digital health, as indicated by secondary material and event attendance, and through snowballing, with the latter aiming to gain insights from ‘behind the scenes’ or hard-to-reach actors such as venture capital investors. Interviews were conducted face-to-face or via Skype and typically lasted 45-120 minutes. The interviews generally served two purposes: to trace how the market for digital therapeutics came about and to establish the interviewees’ own or their organization’s engagement in this process. We stopped interviewing at a point where we had covered all main market actor perspectives and no new insights readily emerged.

We complemented this primary research with an archival search of all English-speaking news outlets 2008-2018. We searched the Nexis database with the search strings “digital health”, “digital therapeutics” and “digital medicine” and variations of these, and subdivided results into years. We also searched Nexis for the most prominent digital therapeutics companies in the US and Europe. We read through the entire database of almost 1,000 articles to identify those that shed light on the evolution of the digital therapeutics market. This yielded 168 articles, to which we added 99 web-based articles and reports not captured via Nexis. To understand in more detail who the relevant market actors were and how they represented the market, we followed #digitalhealth and #digitaltherapeutics on Twitter. We also watched relevant video footage on Youtube, Vimeo and Ted Talks. Finally, we obtained six market research reports on the digital therapeutics market. Table 2 summarizes our empirical data.

======TABLE 2 ABOUT HERE=====

3.2 Data analysis
All secondary data, the verified and de-identified interview transcripts, and field notes were uploaded into QSR NVivo10. The first stage of analysis comprised several readings of the material to draft a detailed event chronology of digital therapeutics, which helped us identify the activities and events that market innovators and stakeholders engaged in over time. We then undertook a first round of bottom-up categorization to code these activities in more detail. While this coding was inductive, driven by what we found in the data (Miles, Huberman and Saldaña 2013), we utilized the five broad market subprocesses discussed above as parent or tree codes, under which more fine-grained inductive codes were nested. We used the following broad questions to guide our analysis: Who was involved in innovating this market and/or who was affected (actors)? How did they relate (actors)? What actions did they engage in (exchanges/representations)? What barriers or resistance did they encounter/mount (actors/norms/exchanges)? How were they overcome (norms/exchanges)? How were actions and events sequenced over time (all five codes/chronology)? How did products and solutions emerge, evolve or change, and how were they qualified (offerings)? How was the market represented and by whom, to what purpose (representations)?

The first author coded all relevant interview, observational and textual data. While it is best practice in qualitative research to triangulate different sources of data, it is equally important to be cognizant of the different insights these sources may offer. For instance, textual data can be read at a descriptive level of analysis, extracting answers to questions such as ‘who has done what at what time and how”, and at an agentic one, which necessitates an analysis of why they were written, by whom, and with what audiences in mind (Geiger and Finch 2016). This latter perspective was particularly important with regard to understanding why certain texts were circulated at specific moments in time and how they contributed to market innovation, an understanding which was deepened through our interview and observational data.
After a first full round of coding, the second author checked a representation of the data against the emergent codes and discussed them with the first author until full agreement over individual codes and their ‘fit’ was reached. As part of this process we recursively queried all our data against the emergent coding structure to ensure that the latter captured the full insights the data offered, and recategorized data where necessary until we were content with the overall fit. Table 3 shows the resulting data structure, including data evidence for each code.

This recursive back and forth between the inductive first-level codes and the parent codes then allowed us, in a second analysis round, to arrive at a more conceptually driven perspective of how the five broad categories of market innovation interacted and what specificities were displayed with regard to combinatorial market innovation. We adjusted these interpretations, presented below, until interpretive convergence was reached – that is, both authors were confident that the theoretical story told was an accurate analytical interpretation of the empirical case material (O’Connor and Joffe 2020). We presented the results to several industry and academic panels knowledgeable with the market and with the theoretical concepts, respectively, for feedback and refinement. For instance, we presented early findings to an industry steering group of an applied research center in digital health to ascertain any gaps in our understanding of the evolution of the digital therapeutics market. We also presented our insights at a strategy meeting of a digital therapeutics company, which afforded us an actor-driven ‘first hand’ perspective of the processes we detected in our data and led to a small number of minor adjustments in our interpretations, for instance over the role of the pharmaceutical industry. We presented our conceptual ideas at a workshop on digital markets to test our arguments around combinatorial market innovation and to increase our sensitivity to alternative explanations.

3.3 Empirical setting
Before presenting our analysis, this brief chronological section introduces our empirical setting and how it evolved from an abstract policy goal to integrate digital technologies into healthcare in early 2000s, through the advent of consumer technology-driven tools in the early 2010s, to a market that situated itself squarely between tech and pharmaceuticals – digital therapeutics. According to the Digital Therapeutics Alliance, digital therapeutics is “a new generation of healthcare that uses innovative, clinically-validated disease management and direct treatment applications to enhance, and in some cases replace, current medical practices and treatments”.\(^3\) It has developed as a distinct market within the broader field of digital health.\(^4\)

Traditionally, healthcare was dominated by two large industries – pharma and med tech – that supplied a range of healthcare providers, but had little if any direct contact with patients. In the early 2000s, growing healthcare costs and rising inequality in access and provision motivated a push to introduce efficiencies into healthcare delivery, emphasize prevention in addition to ‘sick care’, and develop interlinkages between different healthcare providers. Early policy initiatives in the European Union and the U.S were aimed at increasing incentives for healthcare providers to invest in a data infrastructure. Yet, reports from the period noted significant uncertainties linked to digital health tools particularly on the part of healthcare professionals.\(^5\)

Advances in consumer technologies soon created a fertile ground for digital health innovation beyond the hospital setting. In particular, the rapid spread of smartphones from 2007 onwards opened up a new channel to increasingly health-conscious consumers that software companies started to explore. The potential of these consumer-facing, mobile-centric technologies also caught the attention of venture capitalists who started investing heavily in digital health from around 2010.\(^6\) This period coincided with the rapid expansion of a handful of large technology firms (Google, Facebook, Apple, etc.), all of whom started to stake claims in healthcare.\(^7\) The research agency IMS Health summarized the situation in 2013 by noting that most apps
continued to lack evidence of a potential to truly change healthcare provision and outcomes, as they were wedded to a consumer tech philosophy.\(^8\)

By 2013, digital health displayed the typical diversity of early-stage markets, encompassing everything from small app developers to tech giants.\(^9\) While consumer-facing tools dominated, emerging evidence suggested that digital tools could represent a veritable sea change in medical therapies if they acted “either as adjuncts to or substitutes for chemical therapeutics”.\(^10\) In pursuit of this future, a group of companies started coordinating their efforts in late 2016 and early 2017 under the labels of ‘digital therapeutics’ or ‘digital medicine’. To distance themselves from more consumer-oriented products, these companies emphasized that their products were digital-medical hybrids that had proven therapeutic value and could stand up to rigorous clinical testing and regulatory approval. In October 2017, the Digital Therapeutics Alliance (DTA) was launched at the Boston-based Connected Health Conference.\(^11\) Alliance members started producing clinical evidence and using the abbreviation ‘DTx’ for their products, in purposeful analogy with the common shorthand of ‘Rx’ for prescription medicines.

4. Findings

Today, in 2020, digital therapeutics exists as a recognizable market. There is a trade association called the DTA with regular meetings and a visible presence at major healthcare conferences; several digital therapeutics products have been cleared through a novel regulatory pathway by the U.S. Food and Drug Administration (FDA);\(^12\) and distinct reimbursement paths have been created for such products.\(^13\) Yet, as recently as 2014, the terms ‘digital therapeutics’ and ‘digital medicine’ were virtually unheard of.\(^14\) Building on our brief chronological overview in Section 3.3. above, in this Section we analyze how digital therapeutics innovators engaged in
combinatorial market innovation across multiple subprocesses simultaneously to build this market at the intersection of healthcare and IT. Figure 1 presents an overview of our findings.

4.1 Coalescing Exchange Agents

While any act of market innovation requires careful understanding of actor constellations, combinatorial market innovation signals the meeting of two actor worlds that have so far lived relatively unperturbed by each other. It is the task of combinatorial market innovators to bring together central sets of actors from each field, carefully leveraging different relationships and networks to orchestrate this encounter, but also acknowledging and bridging differences in power, values and practices. In our case, DTx innovators faced very powerful incumbents in the healthcare and tech markets. In healthcare, one respondent explained, medical professionals are powerful gatekeepers who are trained to be wary of any innovation until it is truly tried and tested – professional legend has it that it took forty years for doctors to adopt the stethoscope.\textsuperscript{15} As another respondent noted, the two dominant industries serving medical professionals – pharma and med tech – molded their entire operations from R&D to sales around this risk adversity and need for evidence. On the other hand, in consumer tech, very large multinationals started to see the potential of ‘disrupting’ the large and lucrative healthcare market (though, as we point out below, they were typically not very successful in this endeavor\textsuperscript{16}).

Faced with these entrenched and well-resourced incumbents on either side, DTx market innovators positioned themselves as ‘born hybrid’ actors who imported the notion of user centricity from technology design into healthcare, but who also embodied a deep knowledge of the needs and motivations of healthcare actors. Unlike in many cases of tech disruption to markets, where tech firms are often accused of a significant level of arrogance and a tendency toward ‘tech solutionism’ (Geiger, 2020), DTx firms were highly sensitive and responsive to the medics’ need for evidence and trust in medical innovation all while retaining bridges to the
One strategy through which this balancing was achieved was to position themselves as translators and connectors between patients’ needs and medics’ professional ethos. Much of the rhetoric surrounding digital health posited how these technologies as a way to overcome the patient’s dependence on an all-knowing and all-powerful physician and finally “put the healthcare consumers in the driver’s seat”.

With this, patients became important allies in the development of digital therapeutics. Conferences featured them prominently as champions for clinically validated digital tools, and DTx pioneers took pains to highlight patients’ role in the future market: “Fundamentally, the most underutilized person in healthcare is the patient.”

Supporting and disseminating such patient-centric discourses provided DTx innovators with two important benefits: they highlighted the value of data in the healthcare encounter, and they valorized capabilities possessed by actors traditionally located outside the healthcare field:

“Neither pharma nor the medical device industry have ever learned to make the consumer excited, to elicit their feelings. They were working on the principle of manufacturing efficiency, with products made for the doctor at large scale. Now it’s about the consumer who happens to have a health problem now and again, and it’s a completely different approach.” (Investor interview, Dec. 2015)

Unsurprisingly, medical market incumbents were wary of such user-centric discourses and mounted defenses against the new market actors by continuously underlining the ‘exceptionality’ of healthcare. In their view the market displayed a level of complexity that technology companies were simply unable to grasp. To overcome this skepticism, DTx firms carved out an actor identity that was clearly anchored in but also distinct from both healthcare and tech markets; as one of our research participants put it, “we’re a healthcare company with digital in our DNA”. Supporting this identity meant investing heavily in clinically trained staff on the one hand and adopting a medical vocabulary, worldview, and processes on the other, for instance around the role of clinical evidence (see Section 4.2 below). In addition, most DTx
firms also carefully positioned themselves in spaces where patients felt let down by traditional healthcare providers and where medical practitioners were less likely to mount resistance against digital entrants. This allowed DTx firms to selectively play up their tech and clinical credentials, presenting themselves as true hybrids at the center of an overlapping network of actors – an overlap personified through the patient, for whom DTx firms acted as spokespersons and in whose name they fostered partnerships with both tech and healthcare incumbents. Interestingly, with this strategy of coalescing around the overlap, these ‘born hybrid’ actors seemed to be more successful than larger ‘cross boundary disruptors’ (Burgelman and Grove 2007) – tech giants such as Microsoft or Google – who tended to use their resource muscle to ‘disrupt’ the other market. If market creation is about demarcating and controlling new market networks (Santos and Eisenhardt 2009), then combinatorial market innovation is about coalescing and orchestrating disparate existing ones from the intersection.

4.2 Recombining the market offering

The hallmark of combinatorial market innovation is the creation of offerings that retain central features of those in the intersecting markets, but where the combination creates something new and unique – similar to genetic recombination, where the crossing of two sets of genes produces genetic difference. In our case, digital therapeutics offerings recombin core characteristics of medical products (clinical and regulatory validation) and technology tools (shortened R&D cycles, user-centric designs). These combinations were not accidental but rather carefully thought out; as one DTx conference panelist noted: “there are things from the pharmaceutical space that we don’t want to apply” (conference notes, Oct 2017) – in this case referring to the industry’s notoriously lengthy research and development cycles. Our data evidences the work necessary to convince other market actors and particularly buyers of these recombin products.
In its physical form, a digital therapeutic is virtually indistinguishable from a ‘normal’ piece of software. However, in its qualification, it closely mirrors that of a medicine. Indeed, achieving a ‘medical grade’ qualification became the ultimate goal of DTx innovators:

“This [software] is a Class 2 Medical Device, which means we went through randomized controlled trials for several years before launch. What started as an intriguing idea became a true medical product.” (DTx CEO, field notes, Feb 2018)

Two qualification processes proved central to balance out similarity and difference: clinical value from a physician’s perspective and cost effectiveness from a health system’s perspective. Starting with the former, healthcare has highly stabilized qualification practices revolving around a ‘gold standard’ of clinical evidence based on randomized control trials and peer reviewed studies. Practitioners tend to be quick to scorn products that lack such qualification or are based on diverging qualification processes. This problem was highlighted when the American Medical Association’s CEO James Madara dismissed general digital health tools as ‘snake oil’ in his 2016 Annual Meeting address. Evidence of clinical efficacy thus became a key qualification criterion baked into DTx products and their main distinguishing characteristics vis-à-vis ‘consumer grade’ digital health technologies:

“A lot of people coming from technology don’t realize the value of peer-reviewed clinical information published in the appropriate journals… if you start to sell into a part of your client base that is physicians, then you need to be able to show them the data.”

(Consultant, Interview June 2016)

This emphasis on clinical evidence stresses the ‘likeness’ between digital and conventional medicines, but DTx innovators also highlighted how their products could transform what counts as evidence: “you can track and analyze vast amounts of data constantly and at very low cost, which makes digital health ideally suited to the collection of real-world evidence.” Though a clear advantage over conventional medicines, this ability to measure the product’s performance
in use and adapt it in real-time created serious issues in a different market subprocess (market norms and regulation), as discussed below.

Layered onto the qualification of clinical effect is the issue of cost effectiveness. Conventional economic assessment of medical products employs standardized health economic calculations such as Quality Adjusted Life Years (Sjögren and Helgesson 2007). Digital therapeutics proposes to transition to a model where value is calculated from individual data points. While such models are relatively common in technology settings, they completely redefine economic value for healthcare buyers. To support this change, several DTx companies offered “risk-share” revenue models, where the price paid by the healthcare provider depends on the clinical impact of the product. As health/tech hybrids, DTx companies were in a unique position to build these revenue models, which broke with conventional medical device or pharmaceutical pricing processes, but which spoke directly to healthcare buyers’ increasing cost pressures.

In sum, DTx innovators were at pains to qualify their products as clinically equal to conventional medicines while comparable to technology products in economic value and user friendliness. Recombining these heretofore separate qualification methods yielded an entirely new product class – digital therapeutics. Thus, as in genetics, the recombination of features from two separate realms, done thoughtfully, led to objects that are neither one nor the other, but retain central traces of both (cf. Wagner and Rosen 2014).

4.3 Hybridizing modes of exchange

While modes of exchange and use can change independently of market offerings (see Duffy et al. 2020), a significant change in offerings often necessitates new modes of exchange. The recombined digital therapeutics offering brings together two modes of exchange and use that at first do not seem compatible. Medical markets rely on a well-oiled process flow of regulatory approval, market access, distribution and prescription routines, medication habits, and reimbursement via state or private insurers. In technology markets, on the other hand, ‘rapid’
product development continues during commercialization, distribution is usually non-physical, and the payer and consumer are typically the same actor. Combining these two distinct sets of practices begs a number of important questions: “When you’re prescribed a pill-based medication, you probably go to your local pharmacy to pick it up. But if you’re looking for a digital solution for a health problem, where do you go? The app store? Your doctor’s office?”

The dual qualification of digital therapeutics outlined above thus necessitated a parallel rethinking of the mode of exchange that would allow the recombined product to be transacted.

In our case, combinatorial market innovators hybridized familiar exchange patterns from tech and healthcare markets. For instance, Pear Therapeutics’ substance abuse app – the first digital therapeutic cleared by the FDA and the first ever prescription app – can be downloaded by anyone from an app store. But to open it patients must enter a prescription access code, available only from a medical professional, that is valid for 90 days. The recommended ‘dosage’ of the app is four therapy units per day. Despite users’ general familiarity with the individual practices that are hybridized in the DTx market, practice change represented a formidable challenge to innovators. In conversations and interviews, physicians often admitted that their diagnostic and prescription habits had been ingrained for decades. In the case of patients, habits were just as deep-seated, as “consumers haven’t yet adopted the habit of considering an application as medicine, per se.”

DTx innovators knew that hybridizing these two modes of exchange would require considerable education despite actors’ familiarity with the individual exchange practices (getting a prescription; downloading an app from an app store). Leaning too much on either of the conventional modes would also influence actors’ perception of the offering, while skillfully hybridizing both would help anchor its recombinant qualities: the ‘prescription’ would signal medical endorsement and quality while the self-servicing would highlight user centricity and convenience.
One consequence of rethinking the mode of exchange was that infrastructures needed to be in place to enable the exchange and use of the new DTx offerings. Unlike consumer-facing technology products, healthcare products and services in most countries are paid for on different variations of a ‘fee for service’ model, meaning that an insurer, a government agency, or another third party reimburse medical products or services. This is buttressed by an often invisible infrastructural layer consisting of reimbursement codes, insurance forms, patient segments, actuarial processes and payment architectures. As no payment codes existed for DTx, the crucial question became one of ‘who pays’. It took years of concerted lobbying at State and federal levels for the emergence of the first ‘digital only’ medical reimbursement codes, a fact that bears out findings from prior research indicating the considerable efforts it takes market innovators to build or substantially change exchange and use infrastructures.

4.4 Selectively coupling market representations

Combinatorial market innovators’ representational work must aim to balance likeness and difference with the intersecting markets. Similarity lends legitimacy to the new offering, and difference allows for the rallying of support around the innovator (Hargadon and Douglas 2001). This balancing between likeness and difference can be strategically directed in a process reminiscent of the practices of selective coupling that hybrid organizations employ to balance different institutional logics (Pache and Santos 2013).

While Hargadon and Douglas (2001) reflected on the use of product design to influence market representations and Cochoy (2015) considered the use of imagery for this purpose, language use is another important element of influencing market representations. Language travels and circulates easily. In our case, the labelling of the new product proved central for this purpose. The label ‘digital therapeutics’ began to circulate around 2013, when the start-up Omada Health started using it to describe its online pre-diabetes coaching software. Between 2014 and 2017, several other firms started using this label for their evidence-driven health technologies, which
were officially known under the unwieldy regulatory label of ‘software as a medical device’. These firms needed a shorthand to express that their products combined the best of two worlds: the ‘therapeutic’ aspect, established through clinical trials and medical protocols; and the user-friendly design and engagement principles of the ‘digital’ era. Emphasizing this coupling of credentials continuously in their language and representational practices also became necessary to differentiate the emerging market from ‘consumer-grade’ tech products.27

Dedicated ‘representational’ actors can aid this process of delineation and help define, diffuse, and defend market representations (Rinallo and Golfetto 2006). In our case, the DTA was founded with the explicit objective to clarify and emphasize the distinction between DTx and wellness devices.28 To underline this positioning, alternative circulating labels such as ‘digiceuticals’, which were more reminiscent of a non-medical space, were quickly abandoned29:

“I think ultimately as you look at the evolution of the space, you’ll see a drugs versus supplements dichotomy, where there will be lots of things around health and wellness … and then you’ll have a set of things that have been demonstrated in a rigorous, scientific way to directly produce these effects.30

As mentioned above, to underscore this representational divide between tech that belongs to the tech market and the true techno-medical ‘hybrids’, DTA members also started using the abbreviation ‘DTx’ for their products, in purposeful analogy with the shorthand ‘Rx’ for prescription medicines. Enrolling other actors in carrying this representational work also became vital. Soon, market reports specifically dedicated to the ‘digital therapeutics’ market emerged, which predicted the market to grow into a multi-billion dollar opportunity 31 Like any promissory work, circulating representations makes the realization of such futures more and more believable and is thus an important part of market innovation (Geiger and Gross 2017).

4.5 Infusing market norms
Formal and informal market norms - or the visible and invisible rules of the market - evolve both organically and through orchestrated efforts by central (groups of) market actors. Creating or reshaping such norms is rarely the task of individual market actors, particularly if they are resource-constrained entrepreneurs. In addition, in the case of combinatorial market innovation the challenge may not be a lack of market norms, but rather a surplus, as norms may emanate from the two now intersecting markets but may be in tension with each other when combined. Respondents regularly discussed this challenge in terms of sitting “between two stools” and “having to create their own market norms”.

One example of a market norm concerns the pace and mode of innovation characteristic for a market, which will color both the unspoken rules for competition and customers’ expectations in that market. Here, the pharma market is known for its very lengthy, resource-intensive, and highly failure-prone R&D cycles. Competition, as a consequence, plays out over decades rather than months or years, and both customers and regulators expect long periods of draughts between innovative jolts. In tech markets, on the other hand, competition thrives on the basis of frequent, user-driven, and iterative innovation, with customers content to receive ‘beta’ products that change and mature while in use. Combining these two processes is a cultural and normative leap in several aspects, as a pharmaceutical conference speaker explained:

“As an industry we’ve defined a process over time with timelines, competencies, regulatory and medical frameworks, which doesn’t square very well with the rapid iterative processes that we see on the technological side.”

One novel way in which DTx innovators took on board pharmaceutical R&D but infused it with market norms from tech markets was to adopt the notion of the randomized control trial (RCT) as a benchmark to prove superiority over established competitor products. Instead of only utilizing RCTs during product development, like pharma would do, DTx firms run them for continuous product improvement when the product is on the market; one DTx CEO
mentioned that they had “10 mini-randomized control trials happening inside the product right now”. This allowed both to speed up the development process and to add value to potential customers through insights from real-life performance data – something the pharmaceutical industry had sought to gain for decades.

This innovation in the market’s cadence had repercussions on other market norms – particularly regulation. DTx innovators saw regulation as central to gaining stakeholder legitimacy, yet their offerings had to engage regulators in completely new ways:

“How do they regulate software that’s constantly improving, constantly being iterated, get it out there, improve, improve, improve? … How do we balance a fast, agile development world with a slow, careful, considered FDA process?”

33 Regulatory norms differed dramatically between lightly regulated software products and pharmaceutical products. For instance, in a digital randomized control trial it is very difficult to fully blind the experimenters to the identity of the test subjects or to determine a true ‘placebo’ effect.34 The interactions over time between regulators and DTx firms bear witness to a slow rapprochement where firms learned how to build the required evidence base to comply with FDA standards, while the regulatory body in turn learned to discern these new technologies from conventional healthcare products. In 2017, the FDA announced a dedicated digital health unit and a precertification pilot program. The former signals recognition of the existence and specificity of DTx products, the latter acknowledges the regulator’s willingness to learn about the “distinctive nature” of this new market.

From these findings, it seems that if one of the intersecting markets is more heavily constrained by existing norms than the other (as healthcare is in our case) then key normative elements are likely to originate from that market system, but with necessary allowances regarding the hybridity of offerings and the infusion of ideas from the other market. Involved actors will
likely have to engage in concerted educational, lobbying and rallying work to create sets of norms over time that are specific to the hybrid market in question.

5. Discussion

In this section, we elaborate on the issues raised in our conceptual discussion: (1) how to characterize combinatorial market innovation; (2) how the five subprocesses of market innovation intertwine; and (3) what our study may signal about intersections and overlaps of markets more generally. Finally, we derive several managerial implications from our findings.

5.1 Insights on combinatorial market innovation

Throughout the empirical account we stressed different facets of combinatorial market innovation – coalescing, recombining, selective coupling, hybridizing, and infusing – across the five market subprocesses. While the combination of two markets put its mark on all five subprocesses, it played out in different ways in each of them. Fashioning a distinct mode of exchange most visibly generated a hybrid solution, combining features of both ‘parent’ markets. Similarly, the process of configuring exchange agents favored actors with a capacity to bridge between the medical and consumer tech markets rather than those with a strong position in one of them. In contrast to these observations, the qualification of DTx offerings relied more heavily on the qualification practices in medicine than on those in tech markets. Similarly, we observed a relative emphasis on normative frameworks originating in medicine over more informal norms in tech. Both these subprocesses, then, produced a prioritization of one ‘parent’ market over the other. Finally, the process of generating market representations seemed to take on a supportive role, geared towards establishing the unique character of DTx rather than underscoring its hybridity. These findings suggest that combinatorial market innovation need
not play out in one way across all subprocesses, and hence that market innovators may (need to) employ different strategies when engaging in them.

The nuanced efforts we observed and the fact that they drew from and across several markets throws two more general and conceptually relevant issues of market innovation into relief: first, it highlights the fact that in market innovation, a change or novelty in one subprocess will likely engender different variations of changes/novelty in other subprocesses. Second, it allows reflection on the potential interconnections and creative combinations between separate markets; or what Wagner and Rosen (2014) in the biological and technological realms called ‘spaces of the possible’. We engage with each of these topics in turn in the next two sections.

5.2 How do subprocesses of market innovation intertwine?

The model we used to trace the combinatorial market innovation process conceptualizes markets as the ongoing results of five intertwined subprocesses. In our conceptual discussion we noted that there is scope for increased theoretical precision concerning how these subprocesses are linked. The ultimate objective of such conceptual development would be to identify specific patterns in how the five subprocesses intertwine during market innovation. Since our case of combinatorial market innovation involved a highly strategic effort by a group of market innovators we were able to trace the dynamics between the subprocesses in great detail. Based on our findings, we identify three basic types of intertwinement between the subprocesses, which may be transferable to other types of market innovation:

_Sequential interrelation._ This is manifest when one subprocess triggers change in or provides input to a second subprocess. We note several examples of this in our case: The subprocess _establishing market norms_ had a strong initial influence on the _qualification_ of DTx offerings, which drew heavily on medical norms and standards. The formation of the DTA, that is the _configuring_ of a new actor, gave DTx innovators increased control over the _generation of market representations_. A special version of this is _anticipatory sequential interrelation_, when
developments that have yet to materialize in one subprocess set developments in others in motion. Per definition, this type of intertwinement operates via the subprocess generating market representations since this process is capable of generating abstractions. One example is the development of a patient-centric discourse attributing increased agential capacity to individuals in future healthcare. This had agential consequences by valorizing capabilities that were not typically associated with healthcare actors. At the same time, it triggered resistance from such actors, notably physicians, which in turn reinforced DTx innovators’ efforts to establish the medical credentials of their offerings.

**Mutual reinforcement:** This is manifest when two subprocesses unfold in symbiosis, each one reinforcing the other. In our study we could for instance observe this between the processes of configuring exchange agents and establishing market norms. The formalized regulatory structure in healthcare provided clear initial guidance to DTx innovators, whose lobbying efforts led to a recognition from relevant authorities, which further strengthened the innovators’ agential capacities, which made it more important for the authorities to include them in re-regulation projects, etc. The existence of mutual reinforcement dynamics between subprocesses will significantly affect the overall outcome of a market innovation process. Identifying them will offer market innovators insights concerning particularly beneficial process combinations.

**Interference:** This is manifest when one subprocess disturbs or counteracts developments in another subprocess. In our study we could for instance observe this between the subprocesses fashioning modes of exchange and qualifying offerings. The new DTx offerings fit poorly with extant payment/reimbursement models, which were supported by an elaborate administrative infrastructure. This prevented a swift growth of the market even after the value of the DTx offerings had been established. The existence of interference between market subprocesses will require market innovators to find workarounds or ways of temporarily suspending such links.
These three types of processual interrelations, illustrated in Figure 2, extend in important ways Harrison and Kjellberg’s (2016) conceptualization by offering a terminology for mapping how market innovation may unfold in specific cases, allowing the identification of distinct patterns. Current evidence is scattered and may in fact hide large differences in relative importance of the five subprocesses across different types and stages of market innovation. The ongoing realization of markets is an open-ended and situated process that is influenced by the specific actions undertaken by market innovators and the reactions of others to their initiatives. Whether it is possible to identify such patterns at a more general level is a question that future research should focally engage with. Until such knowledge is available, the proposed interrelation terminology should prove highly useful for market innovators and researchers alike.

5.3 Market interdependences and reverberations: overlaps as spaces of the possible

Our final conceptual contribution concerns the market systems literature. Kjellberg and Olson (2017) recently observed a lack of attention to the formation of markets in adjacency to and interaction with other markets. Similar to their study of the formation of legal cannabis markets, our research points to important interdependencies and reverberating effects across markets. While digital therapeutics is admittedly an ‘extreme’ or revelatory case of combinatorial market innovation, many boundaries between markets have become blurred due to changes in regulation and to digitalization (Burgelman and Grove 2007). This boundary bleeding has several consequences for market actors. For incumbents, the more likely it is that disruption to a market’s practices, representations, offerings, or norms emanates from outside their own market, the more broadly anchored their own agency needs to be. In the DTx context we could think for instance of a pharmaceutical firm with a significant digital innovation lab or a consumer tech firm that develops regulatory expertise beyond current requirements.
A blurring of market boundaries may also signal that overlaps and interference may not only be more frequent but also more unpredictable in origin; to give an example, we met a car manufacturer representative at a digital health conference who anticipated that health sensor technology would eventually be a core component of car interiors. These interaction effects obscure the already vexed question of where one market ends and another starts.

Future research into the interactions between markets may find it useful, like we did, to trace the mutations and translations that happen across the five subprocesses when they travel from one market to the next. In Duffy et al.’s (2020) study of a digital secondary ticket market, for instance, the offering remained virtually unchanged but the agency it bestowed altered dramatically due to changes in modes of exchange. We note that where in Kjellberg and Olson’s (2017) case many between-market interactions were what they called ‘referential’ in nature – operating through representations and norms – those we observed affected all five subprocesses, including the more material ones of generating market offerings and modes of exchange. Future research needs to examine such systemic interactions beyond current market boundaries.

Most importantly, as in our case of DTx, conceptualizing market intersections and overlaps as ‘spaces of the possible’ highlights the significant role of creativity in market innovation. Many empirical cases of (combinatorial) market innovation described in the literature seem obvious in hindsight – one needs only to consider Araujo and Kjellberg’s case of frequent flyer points as a reinvention of the grocery sector’s coupon system – yet they required certain market actors to draw the connections between market spaces in the first place. And while some such cases may be due to propitious coincidences, the DTx case shows both the imagination and the perseverance that market innovators display to seize just one of these spaces of the possible.

5.4 Managerial implications

Our findings offer important insights concerning the capacities and skills needed to innovate markets and particularly to navigate and drive combinatorial market innovation; as in many
cases of hybridity, the associated tensions could easily lead to ‘sitting between two stools’ rather than successful recombination. Combinatorial market innovators neither start with a blank slate as in de novo market creation nor seek to modify specific arrangements as in market change. Instead, they engage in a strategic and selective synthesis of two markets, which demands close familiarity with the subprocesses in each, as well as substantial political and networking skills. The continuous and finely tuned play with familiarity and distinction that we described in our case also requires a high level of reflexivity and willingness to learn and adapt. As we pointed out, it was remarkable in our case that small startups seemed much more adept at combinatorial market innovation than the well-resourced ‘cross-boundary disruptors’ from either parent market. We can only surmise from our data that the reflexivity and openness to engage with both markets allowed the ‘born hybrids’ to gain ground where larger firms struggled.

Positioning themselves from the outset ‘in-between’ two markets allows combinatorial market innovators to organizationally and operationally anchor themselves in both markets – for instance by recruiting staff from both parent markets; having physical presence in locations with a confluence of actors from both markets; and nurturing cultures that do not lean too much in either direction (our interviewees repeatedly pointed out how condescending healthcare actors could be towards overenthusiastic ‘tech’ folks). Additionally, the most successful digital therapeutics firms also had CEOs or senior management teams with a pedigree and credibility in both markets. A final and perhaps less obvious point for managerial attention pertains to the financing of combinatorial market innovation. Markets display different typical financing structures that prop firm activities. For tech firms, this is typically venture capital financing. However, as pointed out in our section on market norms, innovation and sales processes tend to take much longer in healthcare, which does not always sit well with VC time horizons. Combinatorial market innovators may therefore be best advised to seek funding from investors who themselves are ‘hybrids’ in their knowledge, understandings and networks.
6. Conclusions

This paper has outlined a type of market innovation process that is not discussed in any detail in the literature, that of combinatorial market innovation. We argue that this type of market development is becoming more prevalent in an era where market boundaries blur and overlaps between markets become more common. More generally, the notion of combinatorial market innovation highlights that market overlaps require the astute combination of heterogeneous market elements in a highly reflective process of synthesis. Recognizing the particular dynamics of combinatorial market innovation, we argue, also offers improved managerial guidance with respect to the strategic market work necessary to successfully innovate markets. Further conceptual and empirical insights into these overlaps or ‘spaces of the possible’ are urgently needed to explore in further detail how actors draw from multiple markets. Such research also needs to establish the extent to which all market innovation may display combinatorial elements. Our case of digital therapeutics acts as an exemplar, but it is likely that newness in markets is more often than not based on recombination. What we portrayed as the three ideal types of market innovation – creation, change and combination – may thus rather be ideal types in a Weberian sense.

Utilizing and extending Harrison and Kjellberg’s (2016) framework of market subprocesses also allowed us to think through the dynamics and repercussions of changes in one market subprocess on other market subprocesses. As mentioned above, clarifying what changes first in market innovation, what follows, and how different subdynamics relate, will allow market studies researchers to conduct more fine-grained analyses of market innovation processes. In particular, it will assist practitioners to translate insights from this stream of research more readily into managerial roadmaps.
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Table 1. Overview of the five market subprocesses (column 1 adapted from Harrison and Kjellberg 2016; columns 2 and 3 authors’ own).

| Subprocess                        | Key points                                                                 | Relevant studies                                                                                       |
|-----------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Configuring exchange agents       | a) Market development is actor-driven and depends on both mundane and strategic actions; who gets involved will affect market development.  
  b) The agency of market actors is malleable and can be influenced strategically to develop a market. | a) Christophers 2015; Doganova and Karnoe 2015; Geiger and Finch 2009; Giesler 2008; Lindeman 2012; Martin and Schouten 2014; Nilsson and Helgesson 2015; Onyas and Ryan 2015; Santos and Eisenhardt 2009; Scaraboto and Fischer 2013  
  b) Araujo and Kjellberg 2015; Cochoy 2008 |
| Qualifying offerings              | a) Offerings require qualification to be exchanged in markets; establishing new categories, altering assessment standards, or improving product qualities affects market development.  
  b) Alternative qualifications trigger contestations since they affect market boundaries and thus alter the competitive landscape. | a) Azimont and Araujo 2007; Finch, Geiger and Harkness 2017; Lawlor and Kavanagh 2015; Navis and Glynn 2010; Rosa et al. 1999  
  b) Finch and Geiger 2011; Geiger and Gross 2018; Giesler 2008; Fuentes and Fuentes 2017 |
| Fashioning modes of exchange      | a) Behavioral patterns & routines ('ways of doing') gradually establish in markets and can be borrowed from other markets.  
  b) Exchange and use practices are of particular interest for understanding and enacting market development.  
  c) Material infrastructures underly and frame these practices. They shape agency through equipping and scripting. | a) Reflected in conceptions of control (Fligstein 1996) and modes of exchange (Kjellberg and Helgesson 2007).  
  b) Exchange practices (Kjellberg and Helgesson 2007); use practices (Shove and Araujo 2010; Stigzelius et al. 2018).  
  c) Hagberg (2016); Fuentes (2019); Duffy et al. (2020); Mellet and Beaufisage (2020) |
| Generating representations        | a) Markets are abstract entities that require representation; the resulting market images may then affect future market actions.  
  b) Market representations are performative; they may help bring about what they claim to depict. | a) Anand and Peterson 2000; Azimont and Araujo 2007; Geiger and Finch 2016; Geiger and Gross 2017; Hagberg and Kjellberg 2015; Rinallo and Golffetto 2006  
  b) Pollock and Williams 2009; Rinallo and Golffetto 2006; Venter et al. 2015 |
| Establishing market norms         | a) Markets are enabled and governed by detailed (informal) rules and supportive material devices.  
  b) Investments in these market norms may be both required and targeted in market development. | a) Burr 2014; Cochoy 2008; Doganova and Karnoe 2015; Ertimur and Coskuner-Balli 2015; Geiger and Gross 2018; Humphreys 2010; Kjellberg and Olson 2017; Lindeman 2012;  
  b) Araujo and Kjellberg 2015; Martin and Schouten 2014 |
### Table 2: Summary of data collection

| Data Type            | Quantity                                                                 |
|----------------------|--------------------------------------------------------------------------|
| Interviews           | 30 (712 transcribed pages)                                               |
|                      | Sector No of respondents                                                 |
| Analysts/academics   | 2                                                                         |
| Conference organisers| 2                                                                         |
| Consultants          | 3                                                                         |
| Government/Policy    | 2                                                                         |
| Healthcare provider  | 4                                                                         |
| Incubator            | 2                                                                         |
| Health Insurance     | 2                                                                         |
| Technology multinational | 1                       |
| Pharmaceutical company| 2                                                                         |
| Patient organization | 2                                                                         |
| DTx Start-ups        | 6                                                                         |
| Venture              | 2                                                                         |
| capitalists/investors|                                                            |
| Total                | 30                                                                        |
| Observations         | 124 hours across 20 events between Sept 2015 and Oct 2018 (97 pages field notes) including Health 2.0, MedX, Health Tech, RockHealth, DTx and Health XL (all San Francisco), Digital Health London, Connected Health Conference Boston, Connected Health Ecosystem Dublin, Health 2.0 San Francisco meet-ups, Haas Berkeley Healthcare Day. |
| Newspaper articles   | 921 downloaded and read; 168 selected for in-depth analysis.              |
| Source: Nexis        | All English news excluding newswires, press releases and websites.        |
|                      | Search term ‘digital therapeutic’ and ‘digital therapeutics’             |
| Web articles and reports | 99                                     |
| Market research reports | 6                                     |
| Videos               | 5 (108 mins)                                                             |
### Table 3: Data structure and evidence

| Theoretical code | Parent code | Inductive codes | Data examples |
|------------------|-------------|-----------------|--------------|
| Coalescing       | Actors      | New actors      | Pfizer follows up successful smoking cessation app with LivingWith, an app for cancer patients (Pfizer press release) |
|                  |             | Identity        | “This is a rapidly-evolving environment and it is important that we work with regulators, patient advocacy groups, providers, payers, and manufacturers to establish foundational industry frameworks and standards.” (DTx CEO on pharmalive.com) |
|                  |             | Power           | “So far, to be honest, we haven’t seen much of the big technology players in health. I think the main reason is the complexity of market access and regulation in healthcare.” (McKinsey & Co) |
|                  |             | Healthcare      | “Physicians are the key actors. As with nondigital medicine, you need to gain the trust of doctors who have the power to prescribe a digital therapeutic to their patients” (McKinsey & Co Report) |
|                  |             | actors          | “Key issue is to understand patient-generated data and how it can be used in the pharma value chain. Pharma knows two types of data: R&D/trial generated data and marketing/focus group generated data. If you come in inbetween, it’s difficult.” (interview) |
|                  |             | Investors       | “We met with a big provider with 10 hospitals. They were interested in some of the DTx offerings. They said ‘We have one mandate reduce the cost of care. We don’t care what your biz model is, we want to understand how we can partner together to reduce our cost of care’” (interview) |
|                  |             | Media and       | “Digital therapeutics are so important because it’s not just digital transforming the supply chain or the demand chain, it’s the ‘thing’ itself – the actual product – that is being transformed” (Pharmaforum) |
|                  |             | consultants     | “Digital medicine is the first time in 36 years that the FDA has created an entirely new product category” (Pharmaforum) |
|                  |             | Patients        | “As digital therapeutics move to cross boundaries of regulatory approval and efficacy data, the healthcare industry will begin to move to a bifurcated world of digital health apps in the same way that drugs are now divided up into largely unregulated supplements and heavily regulated pharmaceuticals” (MobiHealthNews) |
|                  |             | Regulators      | “What is the difference between 300 apps on the app store versus a digital therapeutic? It’s this question of evidence and it’s the risk surrounding the use case” (conference field notes) |
|                  |             | Payers          | “Pricing of DTx is still a big concern for all stakeholders…there’s an urgent need for new pricing structures and payment models. DTx can’t be priced the same way (universally) as pharmaceutical products have been.” (conference field notes) |
|                  |             | Networks        | “Many digital therapies currently require changes to provider processes. For example, if an app tracks dosage and patient-reported symptoms, a provider is usually expected to do something with the data produced. The data requires analysis, and analysis requires time” (McKinsey & Co report) |
|                  |             | Relationship s  | “In the case of digital therapeutics, payers may lag in offering coverage. "We don't expect coverage at scale until we've commercially launched the product” (PRWeb) |
|                  |             | Chasms          | “Digital therapeutics (DTx) are adding new elements to the medical world in the form of a whole new category of treatments, but like any nascent innovation there is much work yet to do to establish their place in the sector…it’s changing the way that we |
|                  |             | Evolution       | |
| Recombining      | Offerings   | New category    | “Digital therapeutics are so important because it’s not just digital transforming the supply chain or the demand chain, it’s the ‘thing’ itself – the actual product – that is being transformed” (Pharmaforum) |
|                  |             | Boundary        | “Digital medicine is the first time in 36 years that the FDA has created an entirely new product category” (Pharmaforum) |
|                  |             | drawing         | “As digital therapeutics move to cross boundaries of regulatory approval and efficacy data, the healthcare industry will begin to move to a bifurcated world of digital health apps in the same way that drugs are now divided up into largely unregulated supplements and heavily regulated pharmaceuticals” (MobiHealthNews) |
|                  |             | What is a DTx   | “What is the difference between 300 apps on the app store versus a digital therapeutic? It’s this question of evidence and it’s the risk surrounding the use case” (conference field notes) |
|                  |             | Consumer product| “Pricing of DTx is still a big concern for all stakeholders…there’s an urgent need for new pricing structures and payment models. DTx can’t be priced the same way (universally) as pharmaceutical products have been.” (conference field notes) |
|                  |             | Medical product | |
|                  |             | How to value    | |
|                  |             | Uncertainties   | |
| Hybridizing      | Modes of exchange | Barriers        | “Many digital therapies currently require changes to provider processes. For example, if an app tracks dosage and patient-reported symptoms, a provider is usually expected to do something with the data produced. The data requires analysis, and analysis requires time” (McKinsey & Co report) |
|                  |             | Payment structure| “In the case of digital therapeutics, payers may lag in offering coverage. "We don't expect coverage at scale until we've commercially launched the product” (PRWeb) |
|                  |             | Meet in the middle| “Digital therapeutics (DTx) are adding new elements to the medical world in the form of a whole new category of treatments, but like any nascent innovation there is much work yet to do to establish their place in the sector…it’s changing the way that we |
|                  |             | Disrupted       | |
|                  |             | How to sell /buy| |
|                  |             | How to use      | |
|                  |             | Evolution       |
deliver healthcare and changing what healthcare can be” (Pharmafourm)
“It’s effectively pioneering a new class of medicine, often dubbed “digital therapeutics.” But any clinically-meaningful digital therapeutic needs to clear two significant hurdles. One, it needs to genuinely engage and inspire the patient, both initially and over time. Two, it must also unequivocally demonstrate efficacy to the medical community by rooting itself in the best science and by producing clinically significant outcomes, just as any traditional drug is expected to do.” (DTx CEO writing in Forbes)

| Selective coupling | Representations | Definitions of DTx Controversies |
|--------------------|-----------------|---------------------------------|
|                    |                 | Using third parties Uncertainties |
|                    |                 | Evolution                        |

“One of the goals of this initiative [the Alliance] was to ‘synch the different definitions of digital therapeutics’ and do so in a deliberate distancing from innovators who ‘simply have hypotheses as to how their intervention achieves results and then go to market with their technology’ (field notes, Oct 2017).
“Digital therapeutics are re-writing our definition of medicine” (MobiHealthNews 2/1/2018)
The Digital Therapeutics Alliance defines the space as “a new generation of healthcare that uses innovative, clinically-validated disease management and direct treatment technologies to enhance, and in some cases replace, current medical practices and treatments.” (DTA website)
Grand View research report: “digital therapeutics market will be worth more than $9 billion in 2025.”
“Building consensus in the industry about how DTx are defined and understood is no easy task, particularly as the technology continues to develop” (Pharma forum deep dive digital therapeutics Jan 2019)

| Infusing | Norms | Regulation Payment norms Clinical norms How to regulate |
|---------|-------|--------------------------------------------------------|
|         |       | Evolution                                               |

“Digital therapeutics companies are proving, via rigorous clinical studies – and even regulatory approval – that connected health technologies can provide measurable clinical benefit, at least as good as some medication,” PCHAIlance (http://oascentral.mobihalthews.com/Rea x)
“Engagement between FDA and the consumer tech world advanced Sept. 26 with the US agency’s announcement of the participants selected for its nascent digital health “Pre-Cert” pilot program.” (FDA website; MobiHealthNews)
“It will be important to have representatives from large tech firms just moving into medtech, traditional medtech companies, and small firms so the agency [FDA] can get a full sense about appropriate best practices for the broad set of possible digital health stakeholders” (FDA representative reported in MedTech Insight)
“It is the “first time that any piece of software has ever been cleared by the agency to treat any disease,” Corey McCann, founder and CEO of Pear, told Medtech Insight. The approximately two years the company spent engaged with FDA in preparation for the reSET approval helped map out a pathway that can be drawn on to accelerate future prescription apps approvals.” (MedTech Insight)
“The earliest digital therapeutic companies are in the unusual position of having to create their own market norms” (Conference fieldwork notes)
“If apps are going to be prescribed, and considered to be a part of treatment on the same level as a drug, they needed to be validated to the same standard as well” (MobiHealthNews)
Figure 1: Combinatorial market innovation
Figure 2: Interrelations between market subprocesses

A) Sequential interrelations

B) Mutual reinforcement

C) Interference
Appendix 1: Secondary sources

1 https://deep-dive.pharmaphorum.com/magazine/disruptive-technologies/pharma-in-the-age-of-acceleration/
2 Digital Therapeutics in the NHS: Report from the Digital Health.London Summit: 24 April 2018. Available at https://digitalhealth.london/digital-therapeutics-in-the-nhs-report-from-the-digital-health-london-summit-24-april-2018/
3 https://www.dtxalliance.org/
4 www.storyofdigitalhealth.com
5 Dixon, Brian E (2007). A Roadmap for the Adoption of e-Health. E - Service Journal, 5 (3), 3.
6 https://www.cbinsights.com/research/digital-health-startup-investment-growth/
7 https://www.cbinsights.com/research/top-tech-companies-healthcare-investments-acquisitions/
8 Quintiles IMS Health (Oct 2013). Patient Apps for Improved Healthcare: From Novelty to Mainstream. Report.
9 https://www.forbes.com/sites/johnnosta/2013/05/19/digital-health-for-dummies/#620763627a1c
10 https://chealthblog.connectedhealth.org/2014/07/29/connected-health-as-a-therapeutic/
11 The four companies are: Akili, an FDA approved video game for children with Attention Deficit Hyperactivity Disorder (ADHD); Propeller Health, which manufactures a sensor-enabled asthma enabler; Voluntis, which offers a companion platform for remote support of a range of medications including cancer and diabetes; and Welldoc, which also operates in the diabetes space with a coaching and education app.
12 Anon. Dec 26 2018 Last accessed on Feb 4 2019 at https://www.mobihealthnews.com/content/digital-therapeutics-get-first-fda-clearance-novartis-focuses-digital-after-announcing-job
13 https://www.ama-assn.org/practice-management/cpt/2019-cpt-codes-offer-new-paths-payment-digital-medicine
14 In 2014, only 14 sources mentioned 'digital therapeutics' in the Nexis database (all English language sources).
15 https://www.medscape.com/viewarticle/446224
16 https://www.forbes.com/sites/robertpearl/2019/12/16/big-tech/#5e285f546d28
17 http://www.pwc.com/us/en/health-industries/health-research-institute.html
18 http://www.mobihealthnews.com/content/how-providence-st-joseph-health-using-tech-engage-empower-patients
19 In digital therapeutics, a collaboration between pharmaceutical giant Novartis and Google’s subsidiary Verily on a glucose-sensing lens was announced with much fanfare in 2013 but was put “on hold” in November 2018. See https://blog.verily.com/2018/11/update-on-our-smart-lens-program-with.html
20 http://www.ama-assn.org/practice-management/digital/medical-innovation-and-digital-snake-oil-ama-ceo-speaks-out
21 Ibid.
22 Chen, J. H. (Feb 7 2017). Who should own the prescription for digital therapeutics? https://medcitynews.com/2017/02/prescription-digital-therapeutics/?utm_content=45883020&utm_medium=social&utm_source=twitter
23 Singer, N. (March 18 2018). Take This App and Call Me in the Morning. The New York Times International Edition. Business/Financial p. 1.
24 McKinsey & Company (Feb. 2018). Exploring the potential of digital therapeutics. https://www.welldoc.com/innovation/digital-therapeutics-drugs-medicines-drug-dichotomy
25 http://www.pwc.com/us/en/health-industries/health-research-institute.html
26 Farr, C. (April 7 2017). Can “Digital Therapeutics” Be as Good as Drugs? MIT Technology Review, 1-12
27 McKinsey & Company (Jan. 2018): Digital therapeutics: Preparing for Take-Off. Report.
28 www.dtxalliance.org.
29 https://medium.com/@Healthy.vc/digital-therapeutics-vs-digiceuticals-defining-the-software-mediated-healthcare-landscape-fd0eb9dbedee
30 Comstock, J. (15 Oct 2018) Digital therapeutics are moving toward a supplement-drug dichotomy https://www.mobihealthnews.com/content/digital-therapeutics-are-moving-toward-supplement-drug-dichotomy
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33 Comstock, J. (Jan 26 2018). Digital health trends and predictions for 2018, part 2. http://www.mobihealthnews.com/content/digital-health-trends-and-predictions-2018-part-2
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