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Contracts Formed by Software: An Approach from the Law of Mistake

By

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Abstract

A 'Contracting Problem' arises when software is used to autonomously enter into contracts without human input. Questions arise as to how and whether there can be an expression of an objective intention to be legally bound. This article considers three leading solutions to the Contracting Problem. The 'Mere Tools Theory', which views software as 'mere tools' of communication, is too harsh as it binds users to any software malfunction. The Agency Approach, which treats software as Electronic Agents, capable of contracting on behalf of their users, is untenable as it ascribes unrealistic characteristics to software. The article submits that the optimal solution is to extend the objective theory of contract. Where software produces an unintended consequence, this should be seen as a mistake. An optimal way of risk allocation is for parties to be bound by the representations of their software, unless the other party has knowledge of the mistake.

Introduction

The formation of a valid contract requires, *inter alia*, an agreement between two or more parties, where each party exhibits an objective intention to be legally bound (the '*Objective Theory of Contract*').[1] The common law employs the test of 'reasonableness', where a court determines whether it was reasonable for the promisee to infer that the promisor possessed an intention to be bound to each specific term of a contract.[2] At present, the common law does not allow a party to preemptively assent to a range of potential contracts to be entered into.[3]

As software develops to become more sophisticated, in some cases, it may act autonomously in forming contracts, requiring little to no human input. The contracting parties may well be unaware of the specific terms of each contract formed by the software they are using. Under the Objective Theory of Contract, no objective intention to be bound can be inferred and thus, theoretically, no binding contract will be created. Chopra and White refer

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1 *Smith v Hughes* (1871) LR 6 QB 597 at 607. Also see Johan Steyn, 'Contract Law: Fulfilling the Reasonable Expectations of Honest Men' (1997) 113 LQR 433.

2 *Smith v Hughes* (1871) LR 6 QB 597 at 607.

3 Tom Allen and Robin Widdison, 'Can Computers Make Contracts?' [1996] 9 HJLT 25 at 47.

to this as the '*Contracting Problem*'.[4] Various proposals have been raised to solve the Contracting Problem, including the 'Mere Tools' Theory,[5] the Agency Approach[6] and the Extended Objective Theory of Contract.[7] These solutions can also be described as rules of attribution, since they determine how and under what circumstances the acts of software will be attributed to its user. This article will show that it is only the third proposal that truly offers a solution to the Contracting Problem, both conceptually and practically.

Aside from this theoretical consideration, a serious practical consideration also arises. The process of contract formation is not always a smooth one and unintended consequences may sometimes result. Contract law determines the allocation of risk in this process and has to maintain an optimal allocation even as developments in software raise new dimensions to contract formation. This article will show that, uniquely, applying the law of mistake together with the Extended Objective Theory of Contract will result in an approach which does not impose undue burdens on parties and which promotes commercial certainty.

Following this introduction, this article will consider the possibility of applying the 'Mere Tools' Theory (below, text following n 8).It will highlight the distinction between 'passive' contract forming mechanisms, which merely relay the representations of the human actors controlling them, and 'active' contract forming mechanisms, which make autonomous decisions such as whether to contract, and under what terms to do so. While the 'Mere Tools' Theory may resolve the Contracting Problem in cases of 'passive' contract forming mechanisms, this article argues that it will ultimately fail to do so in cases of 'active' contract forming mechanisms. The article will then address the Agency Approach and show that while it might be superficially attractive to have independent 'Electronic Agents' with separate legal personality, there are fundamental difficulties with the idea and it is ultimately untenable (below, text at n 20).

This article then lays out the proposal of an Extended Objective Theory of Contract, which would allow parites to agree in advance to accept any contract entered into by the software they have chosen that is within pre-set parameters (below, text following n 48). It argues that this is a logical development of the law of contract, which has on numerous occasions adapted to reflect changing commercial realities, often those brought about by technological development. The article then explains how the law of mistake may be used together with the Extended Objective Theory of Contract to achieve an optimal allocation of contractual risks that may arise in the process of contract formation (below, text following n 53). Where unintended consequences have resulted, the law of mistake will allow a party to rely on the representation made by the software of his counterparty unless he objectively has reason to believe that the latter (or the latter's software) has made a material error in the process of contract formation. In this way, contractual certainty is preserved, while the 'mistaken' party is not unduly taken advantage of.

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4 Samir Chopra and Laurence White, 'Artificial Agents and the Contracting Problem: A Solution via an Agency Analysis' [2009] University of Illinois Journal of Law Technology & Policy 363.

5 Emily Weitzenboeck, 'Electronic Agents and the Formation of Contracts' [2001] 9(3) IJLIT 204 at 226.

6 Chopra and White, above, n 4.

7 Allen and Widdison, above, n 3 at 43-44.

The 'Mere Tools' Theory[8]

The 'Mere Tools' Theory proposes that software should be treated as mere communication tools of the user and thus, any representations which they make should be treated as a representation of the user. Any transaction that is entered into by the software is considered an act of the user and is binding upon him. To understand the limitations of the 'Mere Tools' Theory, it is necessary to appreciate the distinction between 'passive' and 'active' contract forming mechanisms.

'Passive' Contract Forming Mechanisms

A contract may be formed by the simple offer and acceptance of contractual terms by two parties meeting in person. However, parties may also rely on various other contract forming mechanisms that would help them to contract without needing to be in each other's presence. 'Passive' contract forming mechanisms do no more than act as a communication device, relaying the representations of the user without altering it in any way.[9] The use of 'passive' contract forming mechanisms are completely in line with the Objective Theory of Contract, given that each party exhibits, through the communication device, an objective intention to be legally bound to each specific term of a contract.

As new 'passive' contract forming mechanisms developed, the law of contract accordingly adjusted the allocation of risks in the process of contract formation, attempting to achieve a fair outcome. The communication devices used by parties would sometimes fail, resulting in the need for attribution of risk. The Postal Acceptance Rule was one such rule which placed the risk on the offeror by deeming acceptance to have taken place at the point of posting of a letter of acceptance by the offeree. The offeree would be deemed to have accepted an offer even if, due to some mishap, the letter of acceptance never actually reached the offeror.[10] As Lord Herschell held in *Henthorn v Fraser*:[11]

> Where the circumstances are such that it must have been within the contemplation of the parties that, according to the ordinary usages of mankind, the post might be used as a means of communicating the acceptance of an offer, the acceptance is complete as soon as it is posted.

As other new communication technologies such as telexes, fax machines and email were adopted, the law of contract continued to develop, with variants of the Postal Acceptance

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8 Weitzenboeck, above, n 5 at 226.

9 Jane Winn and Benjamin Wright, *The Law of Electronic Commerce*, 4th edition, Aspen Law & Business, 2000.

10 *Household Fire Insurance v Grant* (1879) 4 Ex D 216; *Henthorn v Fraser* [1892] 2 Ch 27; and *Holwell Securities v Hughes* [1974] 1 WLR 155.

11 *Henthorn v Fraser* (n 10) [1892] 2 Ch 27 at 33.

Rule being applied. The Rule itself was stretched and modified to suit the various different circumstances.[12]

As the use of machines became widespread, the law of contract extended the established model of forming unilateral contracts by placing an advertisement in the newspapers[13] to such situations, allowing the use of machines that would automatically form a contract with any willing party, without the need for the further express action of an instructing party.[14] With the advent of e-commerce, such machines took the form of websites online. Winn and Wright trace the use of software technology for the purposes of contracting to the 1980s, where Electronic Data Interchange ('*EDI*') software was used to place orders and exchange information.[15]

While the various kinds of 'passive' contract forming mechanisms required the law of contract to constantly adapt and adjust the allocation of risk between the parties, all such mechanisms were similar in that they were mere tools of communication, passively relaying the representations of the user.

'Active' Contract Forming Mechanisms

In comparison to 'passive' contract forming mechanisms, 'active' contract forming mechanisms are a much more recent development, relying on, *inter alia*, artificial intelligence and machine learning to aid or even almost entirely replace a human user in the process of contract formation. Instead of merely relaying the user's representation in a 'passive' manner, new technologies are actually are able to autonomously decide the terms and conditions of the electronic contracts and execute those contracts. The role of the human operator is limited to stipulating the rules or objectives that guide the electronic agents in the process of contracting. He does not directly participate in the process of contracting or in the determination of the final contract. In certain situations, we might not even be able to predict the result generated by the software, as in the case of 'robo-adviser' software, which may be used to provide advice on stock market transactions.

Such 'active' contract forming mechanisms do not fit neatly within the Objective Theory of Contract. Conceptual questions may be raised, such as whether there can be a meeting of the minds if neither party knew terms of the particular contract entered by their software at the time of the transaction. In the absence of any such *consensus ad idem*, one might even question as to whether an agreement can ever validly be reached when such mechanisms are used.

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12 *Entores v Miles Far East Corp* [1955] 2 QB 327; and *Brinkibon Ltd v Stahag Stahl und Stahlwarenhandelsgessellschaft GmbH* [1983] 2 AC 34. Also see Donal Nolan, 'Offer and Acceptance in the Electronic Age', in Andrew Burrows and Edwin Peel, eds, *Contract Formation and Parties*, OUP, 2010.

13 *Carlill v Carbolic Smoke Ball Company* [1893] 1 QB 256.

14 *Thornton v Shoe Lane Parking* [1971] 2 QB 163.

15 Winn and Wright, above, n 9.

To illustrate this issue, consider the example of trading algorithms employed by investment banks such as Goldman Sachs. These algorithms automatically price and execute trades without intervention from human users.[16] The firm and its employees could set the parameters of the algorithm such that it only deals with small sized trades of corporate bonds.[17] While they would be aware of the general class of transactions entered into, they would not be aware of the price, size and timing of specific, individual transactions nor the bonds that are being transferred.

In terms of risk attribution, the law of contract is not particularly clear as to how the risks of contract formation should be allocated between the contracting parties. Software may exhibit a wide range of possible erroneous behaviours for various reasons. These include, *inter alia*, 1) a bug or error in its program caused by the carelessness of the software programmer; 2) some defect in the hardware on which the software runs; and 3) a design fault arising due to a lack of understanding of the underlying mechanisms of the software.

While the Singapore case of *Digilandmall*[18] hints at the potential approach that the courts may adopt in such situations, the lack of judicial precedent in this area prevents the drawing of more concrete conclusions. In *Digilandmall*, an accidental alteration to the three websites of a company in the course of designing a training template resulted in a massive reduction in the listed price of a printer. The Singapore Court of Appeal applied the doctrine of unilateral mistake to prevent several people who had seized the opportunity to purchase multiple printers from exploiting the situation. However, in *Digilandmall*, the situation was one of human error and not erroneous behaviour by the software itself. It remains to be seen how a court will deal with a case of genuine 'software error'.

'Passive' and 'Active' Contract Forming Mechanisms and the 'Mere Tools' Theory

The 'Mere Tools' Theory provides a straightforward solution to the contracting problem. If the representations made by the software are deemed to be the representations made by the user, then there is no question of a lack of an objective intention to be legally bound to each specific term of a contract. However, the 'Mere Tools' Theory has some apparent and serious drawbacks. While it might well apply when software is used in a 'passive' manner, the artificiality of the approach quickly becomes apparent when applied to software used in an 'active' manner.

Software used in a 'passive' manner such as email software are indeed 'mere tools' since their function is limited to serving as a proxy mechanism through which parties could communicate their representations. The 'Mere Tools' Theory is immediately exposed as an unrealistic fiction once we consider software used in an 'active' manner such as 'robo-

16 Robin Wigglesworth and Joe Rennison, 'Goldman Expands Algorithmic Corporate Bond Trading', Financial Times, 16 August 2017, available at https://www.ft.com/content/6d15c274-70ec-11e7-aca6-c6bd07df1a3c, (accessed 11 January 2018).

17 Wigglesworth and Rennison, above, n 16.

18 *Chwee Kin Leong v Digilandmall Pte Ltd* [2005] 1 SLR(R) 502 (hereafter *Digilandmall*).

adviser' software. As the role of the human operator is limited to stipulating the rules or objectives that guide the software in the process of contracting, it is clearly at odds with reality to suggest that the 'active' software was a 'mere tool' of communication. The software acts autonomously and one might even go so far as to suggest that in some cases the software has more 'input' on the final contract that the human operating it.

The allocation of risk between the contracting parties under the 'Mere Tools' Theory also leaves much to be desired. The Theory deems any transaction that is entered into by the software as an act of the user. In doing so, it imposes an extremely harsh burden on the user. As Weitzenboeck points out, the user will be liable for contracts that were unintended by him should the software behave erroneously.[19] As such, the 'Mere Tools' Theory would seem to be a blunt instrument which is at odds with commercial reality and which unfairly allocates a considerable amount of risk to the user. The user will be bound by the acts of the software even where the software has acted in such a wildly irrational manner such that the other contracting party could not possibly believe it to be functioning normally.

It is noted that while this article draws a distinction between software playing a 'passive' and software playing an 'active' role, these are but extreme ends of a spectrum of possible technologies. Indeed software may lie at any point of the spectrum, depending on the needs of the user and the extent of the desire to automate various situations of contract formation. However, there is a need for any theory of software formed contracts to be able to encompass cases lying at all points of the spectrum. The 'Mere Tools' Theory demonstrably fails to satisfy this requirement.

The Agency Approach

Unlike the 'Mere Tools' Theory, the Agency Approach recognises the 'active' nature of software used in contract formation. It posits the existence of independent 'Electronic Agents' with separate legal personality, capable of entering into contracts on behalf of its users. In doing so, it attempts to circumvent the Contracting Problem through the application of the law of agency. Notwithstanding that the users may not themselves have an objective intention to be legally bound to each specific term of a contract, the Electronic Agents would make representations as to such an objective intention, which could then be attributed to the human principals.

The concept of an 'Electronic Agent' based on the law of agency can be traced back to Kerr,[20] and has been supported by other writers such as Chopra and White.[21] Agency can be defined as a relationship where the agent acts on behalf of the principal. The agent is an entity or person separate from the principal with its own legal personality. The acts of the agent can establish a contractual relationship between the principal and third party. This

[19] Weitzenboeck, above, n 5 at 226.
[20] Ian Kerr 'Ensuring the Success of Contract Formation in Agent-Mediated Electronic Commerce' [2001] 1 Electronic Commerce Research 183.
[21] Chopra and White, above, n 4.

relationship of agency arises from the authority conferred by the principal upon the agent, which comes in three forms: 1) actual express authority, which arises through express words of consent from the principal to the agent that the agent is to act on his behalf;[22] 2) actual implied authority, which arises through implied consent inferred from the words or conduct of the principal;[23] and 3) apparent authority, which arises when the principal has made representations to the third party that the alleged agent was acting under his authority.[24]

The doctrine of authority limits the liability of the principal to acts done by the agent while under actual or apparent authority. Any transaction arranged by agents acting outside of their scope of actual or apparent authority is not contractually binding on the principal.[25]

The Agency Approach appears to be an attractive solution because to some extent, it reflects the reality that the use of 'active' contract forming mechanisms delegates part of the decision-making process to the software, resulting in a loss of some control over the process of contract formation. There are some similarities between human agents and Electronic Agents. Both act independently in the absence of significant control by the principal (*i.e.* the user in the case of an Electronic Agent). Further, much like how a principal defines the scope of authority of his agent, the user sets the parameters of operation for his Electronic Agent. The question thus arises as to whether, where the software acts as an intermediary to carry out the wishes of the contracting party, a relationship akin to agency arises. In some cases, there is so little actual external input from any party that one might quite reasonably question whether the party has not completely placed the task of contract formation in the hands of his 'agent'.

Take Amazon for example. Amazon is a leading American electronic commerce company based in Seattle, Washington. The online retailer does not employ humans to determine prices of the products listed on its website or to manually process its orders. In fact, doing so would be impossible as Amazon receives 35 orders every second,[26] amounting to 1.1 billion transactions a year. Instead, the prices are determined by an Electronic Agent (in this case the Amazon website running on Amazon servers) that takes into account a variety of factors such as its users' browsing data, geography, past purchases and even the time of the day. Similarly, in the finance industry, trading algorithms execute trades autonomously by collecting and interpreting market information.[27]

In addition, industries and companies have begun to employ Electronic Agents with artificial intelligence. These advanced Electronic Agents have the ability to generate and

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22 *Hely-Hutchinson v Brayhead Ltd* [1968] 1 QB 549.

23 *Hely-Hutchinson v Brayhead Ltd* [1968] 1 QB 549.

24 *First Energy UK Ltd v Hungarian International Bank* [1993] 2 Lloyd's Rep 194; and *Criterion Properties plc v Stratford UK Properties LLC* [2004] 1 WLR 1846; [2004] UKHL 28. Also see Francis Reynolds, 'The Ultimate Apparent Authority' (1994) 110 LQR 21.

25 *Criterion Properties plc v Stratford UK Properties LLC* [2004] 1 WLR 1846; [2004] UKHL 28.

26 Ingrid Lunden, 'Amazon's Prime Day was the biggest sales day in its history, up 60% on 2016 led by the Echo',TechCrunch, 2017, available at https://techcrunch.com/2017/07/12/amazons-prime-day-was-the-biggest-sales-day-in-its-history-up-60-on-2016-led-by-the-echo/?ncid=rss (accessed 11 January 2018).

27 Emiko Terazono, 'Commodity Investors Embrace Algorithmic Trading', Financial Times, 6 July 2017, available at https://www.ft.com/content/c386de76-61a2-11e7-8814-0ac7eb84e5f1 (accessed 11 January 2018).

optimise their own algorithms using past experiences.[28] Artificial intelligence software works by gathering input and feeding the input data through layers of electronic neurons to produce an output. The connections between the electronic neurons will adapt iteratively to optimise the software's decision-making ability in a manner that resembles neurons in the human brain.[29] As compared to traditional algorithms, the logic with which artificial intelligence software operate is not determined by the programmer beforehand. Thus, computer scientists often do not fully understand the self-determined decision-making processes of the artificial intelligence software they design.[30] While these Electronic Agents might work predictably in circumstances similar to situations they have encountered before, the decisions they make in novel situations are less certain.

Strengths of the Agency Approach

Intuitive benefits

Chopra and White argue that the Agency Approach carries both 'intuitive' (clearly apparent) benefits and economic benefits.[31] The intuitive benefits of the Agency Approach are that existing theoretical frameworks under the law of agency may be utilised to clarify the nature of contractual relations formed by Electronic Agents. These theoretical frameworks include the doctrine of authority and the doctrine of ratification.

The doctrine of authority is useful in that it limits the scope of liability of users to acts performed by the Electronic Agents they employ. The authority of an Electronic Agent is defined as the parameters set by the user, rather than the detailed instructions by which the software is programmed. The doctrine of ratification is also suggested to be a useful concept. Under the doctrine of ratification, when an Electronic Agent has entered into a contract outside of its scope of authority, the principal can retroactively ratify the contract, rendering it binding upon itself and the third party. For the doctrine to apply, the principal's identity must have been ascertainable by the third party.[32]

Economic efficiency

Chopra and White further argue that the law of agency is economically efficient as it correctly allocates the risk of erroneous activity by the Electronic Agent on the party that would expend the least cost to avoid the error (*viz.* the '*least cost avoider*').[33]

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28 Will Knight, 'The Dark Secret at the Heart of AI', MIT Technology Review, 11 April 2017, available at https://www.technologyreview.com/s/604087/the-dark-secret-at-the-heart-of-ai, (accessed 11 January 2018).

29 Alex Krizhevsky, Ilya Sutskever and Geoffrey E Hinton, 'ImageNet Classification with Deep Convolutional Neural Networks' [2012] Advances in Neural Information Processing Systems 1097.

30 Krizhevsky, et. al., above, n 29.

31 Chopra and White, above, n 4 at 403.

32 *Hagedorn v Oliverson* (1814) 2 M & S 485; 105 ER 461; and *Boston Fruit Co v British and Foreign Marine Insurance Co* [1906] AC 336.

33 Chopra and White, above, n 4 at 394.

If an Electronic Agent is functioning properly, it will either have actual express authority or apparent authority unless the user has made an error in giving instructions. In terns of risk attribution, it is more economically efficient to impose a burden on the principal to ensure that the instructions given are correct. It is costlier to place the burden on the third party to investigate whether any mistakes have been made by the principal, as the third party will not be in a position to do so.[34]

However, there may be cases of 'obvious agent malfeasance' (*viz.* agent behaviour clearly outside the scope of its authority) or where it is clear that the instructions given by the principal to the Electronic Agent are erroneous. In such cases, it is more economically efficient to impose a burden on the third party given the ease of discerning whether the agent is acting outside its scope of authority.[35] In contrast, the principal does not generally receive the representations made by the Electronic Agent and would not be in a position to be able to tell if a mistake has been made.

Drawbacks of the Agency Approach

While the Agency Approach might appear enticing, it is essential to note that the law of agency also encompasses concepts that are incongruous with other aspects of Electronic Agents. These difficulties arise from a fundamental difference between an ordinary agent and an electronic one: while the former (be it a human, company or any other legal entity) can assume legal personality, the latter cannot.

The first and most apparent problem is that Electronic Agents are unable to consent to an agency relationship. As mentioned above, agency with actual authority requires consent between the principal and the agent. Bellia argues that such consent is necessary to justifiy the fiduciary duties assumed by the agent towards the principal,[36] *e.g.* duties of obedience, care and skill, avoiding improper conduct, giving information and so forth. It is unrealistic to suppose that, based on the current stage of technological development, Electronic Agents possess the requisite capacity to understand and consent to an agency relationship.

The second problem is that the normal fiduciary duties assumed by a legal agent cannot be imposed an Electronic Agent. It is conceded that it is certainly possible to program an Electronic Agent to achieve outcomes consistent with the above-mentioned fiduciary duties. However, this mechanical analog of fiduciary duties does not allow the Electronic Agent to be legally bound when any malfunction results in the software failing to achieve those outcomes. As Bellia argues, this creates a significant problem as the principal will be legally responsible for any conduct of the Electronic Agent under its authority. With the increasing capability of Electronic Agents to perform incidental functions, such as borrowing

34 Chopra and White, above, n 4 at 380- 381.
35 Chopra and White, above, n 4 at 399.
36 Anthony Bellia, 'Contracting with Electronic Agents' [2001] 50 Emory Law Journal 1047 at 1060-1062.

money and sub-delegation of tasks to other Electronic Agents, this could lead to principals being liable for messy and unintended outcomes without legal recourse.[37]

Third, in a normal agency context, an agent who enters into a contract with a third party impliedly warrants that he has authority to do so. However, in the case of an Electronic Agent, the third party cannot sue an Electronic Agent for breach of this warranty if it acts outside the scope of its authority. This is because the Electronic Agent lacks legal personality. Thus, this legal protection offered by the law of agency to third parties is not available to contracts formed by Electronic Agents.[38]

The problems highlighted above demonstrate that the agency approach runs into difficulty as only select concepts are applicable to Electronic Agents while other key concepts are not. Thus, to transplant the law of agency over to Electronic Agents would require 1) conferring legal personality upon Electronic Agents; or 2) jettisoning significant portions of the law of agency, especially the internal aspect (i.e. the rules governing the relationship between the principal and agent), both of which are difficult to justify. The difficulties of each option are discussed below.

Giving Electronic Agents legal personality[39]

Legal personality could theoretically be conferred upon Electronic Agents, similar to how corporations and other legal entities are treated as legal persons under the law. However, as Bellia points out, this would be difficult because Electronic Agents are incapable of exercising judgment and understanding, breaching the fundamental rule that a person *non compos mentis*, has no legal discretion or understanding to bind a principal.[40]

Another problem, as highlighted by Habibzadeh, is that non-natural persons that possess legal personality do not act independently. Instead, they are composed of natural persons who act on their behalf. In contrast, an Electronic Agent would be directly engaged in formation of contracts.[41] Indeed most of the utility of an Electronic Agent derives from the fact that it can act independently without the need for natural persons to act.

Alternatively, Electronic Agents could be conceived of as natural persons with a moral entitlement to legal personality.[42] However, at the current stage of technological development, it is difficult to argue that any Electronic Agent is conscious of its own actions

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37 Bellia, above, n 36 at 1061-1063.

38 Bellia, above, n 36 at 1067.

39 This idea was proposed by the European Union Committee on Legal Affairs in a report submitted to the Commission on Civil Law Rules on Robotics (see http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+REPORT+A8-2017-0005+0+DOC+PDF+V0//EN (accessed 11 January 2018). This prompted a strong reaction from those working in this area, with 285 experts signing an open letter to the European Commission to oppose such a proposal (see http://www.robotics-openletter.eu/) (accessed 11 January 2018).

40 Bellia, above, n 36 at 1063.

41 Taher Habibzadeh 'Analysing legal status of electronic agents in contracting through interactive websites: comparative study of American, English and EU laws developing Iranian legal system' (2016) 25 Information & Communications Technology Law 150 at 163-164.

42 Allen and Widdison, above, n 3 at 28-30.

and has the capacity to understand the implications of its decisions. Overall, it is not feasible to confer legal personality upon Electronic Agents.

Altering the law of agency

The other option would be to keep the external aspects of agency, which relate to the principal and the third party, while casting off the internal aspects of agency, which relate to the principal and the agent. This is objectionable for a few reasons.

The most immediate and apparent issue is that applying only the external aspects of agency would create inconsistency within the law of agency. To call Electronic Agents 'agents' would be misleading and confusing due to the large disparity in their legal status compared to ordinary agents. While Chopra and White note that the external aspects do the 'heavy lifting' to bind principals to third parties,[43] the internal aspects of agency represent a fundamental and substantial part of the law of agency. To label a software as an 'agent' when it does not possess the capacity for legal personality is a misnomer.

If only the external aspects of agency are applicable, a more straightforward approach would be to introduce legislation with provisions similar to the doctrine of authority. The Unified Computer Information Transactions Act ('*UCITA*') introduced in certain states of the United States of America does something close to that effect. Section 107(d) of the UCITA states that a person is bound by the operations of the Electronic Agent that he selected even if he was unaware of its operations. Commentary on the section is as follows:[44]

> The concept here embodies principles like those in agency law, but it does not depend on agency law. The electronic agent must be operating within its intended purpose. For human agents, this is often described as acting within the scope of authority. Here, the focus is on whether the agent was used for the relevant purpose.

The Australian Electronic Transactions Act 1999 lays down a similar rule that a person is bound by an electronic communication sent with his authority, which has the benefit of conceptual simplicity.[45] Provisions similar to those in the UCITA and the Australian Electronic Transactions Act can be enacted to extract the desirable elements of the law of agency without the undesirable distortion of its legal concepts.

Some writers have drawn an analogy between Electronic Agents and slaves in ancient Rome who were able to bind their masters to contracts which they had formed even though they were not recognised as legal persons.[46] However, as Habibzadeh points out, this analogy possesses some overt flaws. While humans can display an intention to be bound, it is rather contrived to argue that electronic agents have the consciousness necessary to form such an

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43 Chopra and White, above, n 4 at 401.

44 Uniform Computer Information Transactions Act 2002 § 107, § 107 cmt. 5.

45 Australian Electronic Transactions Act 1999 (Act No. 162 of 1999 as amended), s 15(1). Note that s 15(2) of the same Act goes on to say that the provision is 'not intended to affect the operation of law (whether written or unwritten) that makes provision for (a) a conduct engaged in by a person within the scope of the person's actual or apparent authority to be attributed to another person; or (b) a person to be bound by conduct engaged in by another person within the scope of the other person's actual or apparent authority.'

46 Kerr, above, n 20; and Chopra and White, above, n 4 at 399.

intention. Furthermore, the law of slavery has long been abolished globally.[47] It is anachronistic concept that does not provide a strong justification for the recognition of agents without legal personality.

Another issue is that severing the internal aspect of agency would defeat the normative justifications of the doctrine which assume the existence of both aspects. With the agent not possessing any legal personality, the principal and third party are not protected from the risk of software malfunctions that might result in: 1) a breach of fiduciary duty towards the principal; or 2) the creation of unauthorised contracts that the third party might mistakenly rely upon under a 'warrant of authority' from the agent. The principal and third party in this case clearly cannot sue the Electronic Agent for their losses.[48] Lastly, the economic efficiency generating by applying the doctrine of authority can be better achieved through the application of the law of mistake, as shall be addressed later in this article.

Extending the Objective Theory of Contract

As early as 1996, Allen and Widdison suggested that future courts could extend the objective intention theory of contract to give validity to contracts formed by software. The requirement of intention can be relaxed to make room for a 'generalised and indirect intention to be bound by computer-generated agreements.'[49] Another way to frame this approach is that the parties can express a prior intention to be bound by all contracts within a certain class or type entered via their contract forming software, rather than a specific contract. The reasonableness test can be tweaked such that a contract is binding so long as the promise made by the software on behalf of the promisor can be reasonably inferred by the promisee to come within the generalised intention of the promisor.

This proposed extension of the objective theory of contract is desirable for a few reasons. First, it is justified on the normative ground of fairness. Since the user has chosen to employ the use of contract forming software, he should assume the risk of doing so by accepting liability when it is reasonable for the other party to assume that his software is functioning as he had intended.

Second, the extension of the objective theory of contract promotes certainty. If a subjective standard were applied to determine the intention of the user, it would be impossible for the other party to know, with any certainty, whether the contract forming software was acting consistent to its principal's intention. The test of reasonableness under the objective theory of contract is a clear and accessible benchmark to determine the existence and validity of a contract. This reasonableness can be interpreted based on the accepted industry standards and expectations for transactions.

47 Habibzadeh, above, n 41 at 166.
48 Bellia, above, n 36 at 1067.
49 Allen and Widdison, above, n 3 at 43-44.

Third, while the extension of the objective theory of contract might not be entirely consistent with established principles of contract law, it is an incremental and logical extension that is necessary to enable the common law to keep pace with technological development in commerce. As seen above, text following n 8, the common law is no stranger to the idea of adapting to reflect commercial realities. Further, such an extension is less drastic than the Agency Approach, which substantially alters the doctrine of agency by removing its 'internal' aspects.

The common law already recognises the validity of a general offer made to the world at large in unilateral contracts (*e.g. Carllil v Carbolic Smoke Ball Company*).[50] Unilateral contracts occur daily when anyone purchases a drink from a vending machine or buys a parking ticket from an automatic ticketing machine.[51] Unless he is constantly monitoring the machine, the owner or operator of the vending machine would be unaware of the specific drink purchased by a customer in a specific transaction. Similarly, the owner or operator of the carpark possesses no awareness of the specific contracts that he might enter into since the price of each ticket depends on the length of time the customer parks his vehicle. By placing these machines in operation and relying on them, the owners or operators are inferred to have evinced a general intention to be bound by all the different permutations of transactions their machines can handle. The similarity of these machines to 'active' contract forming mechanisms is immediately apparent. A notable difference would be that in the use of 'active' contract forming mechanisms, contracts could be formed by two parties each using his own software program, and thus *both* the offeror and offeree would be unaware of the specific transaction entered into.

Thus, recognising a general intention to be bound by a class of contracts is not without precedent in the common law. It has long been recognised and applied by the courts in analysing unilateral contracts. Extending this concept to a limited class of contracts formed by 'active' contract forming mechanisms would be an incremental development rather than a radical and unprecedented change in the law of contract. The courts have long taken inventive approaches to adapt the law of contract to new commercial practices. In *Carlill*, the Court of Appeal adapted the concept of unilateral contracts in response to an advertisement offering a conditional reward.[52] A similar adaptation could be made when analysing contracts formed by 'active' contract forming mechanisms so as to keep pace with the development of software and its use in commercial transactions.

Fourth, an extension of the objective theory of contract is necessary to ensure the consistency of the common law principles governing contract and government legislation. Article 8(1) of the United Nations Convention on the Use of Electronic Communications in International Contracts ('*ECC*') states that electronic contracts, in and of itself, 'shall not be denied validity or enforceability'. Article 12 ECC goes on to state that a 'contract formed by the interaction of an automated message system and a natural person, or by the interaction of automated message systems, shall not be denied validity or enforceability on the sole ground

50 *Carlill v Carbolic Smoke Ball Company* [1893] 1 QB 256.
51 *Thornton v Shoe Lane Parking* [1971] 2 QB 163.
52 *Carlill v Carbolic Smoke Ball Company* [1893] 1 QB 256.

that no natural person reviewed or intervened in each of the individual actions carried out by the automated message systems or the resulting contract.'

Article 9(1) of the European Union Electronic Commerce Directive 2000/31/EC similarly provides that Member States should ensure that their legal system 'allows contracts to be concluded by electronic means' and ensure that national laws do not 'create obstacles for the use of electronic contracts nor result in such contracts being deprived of legal effectiveness and validity on account of their having been made by electronic means.'

Thus, the common law has to accommodate this provision by accepting some form of prior intention from the user to be bound by the representations of the 'active' contract forming mechanism which he has chosen to use. It is worth noting that the legislation cited above do not in themselves address the Contracting Problem as they do not explain the theoretical legal basis or rule of attribution through which these contracts are given validity or enforceability. Neither do these provisions define any rules for determining the scope of liability of the contracting parties when a contract is formed as a result of erroneous behaviour by the 'active' contract forming mechanisms.

Overall, the extension of the objective theory of contract seems to be justified both on the normative grounds of fairness and commercial certainty, and on the legal ground of being an incremental and measured approach. Nevertheless, this approach can be further augmented by the law of mistake. Doing so will further clarify the boundaries of liability in contracts formed by 'active' contract forming mechanisms.

Contracts Formed by Software and its Interaction with the Law of Mistake

The common law does not preclude the application of the law of mistake in cases where contracts are formed by software. Indeed, as noted above, the law of mistake has been applied in *Digilandmall*.[53] A distinction may be drawn between cases where a dispute arises when the contract is formed by software, but the use of software is not a material point of the dispute ('*Orthodox Cases*'); and cases where a dispute arises precisely because the risk of using of 'active' contract forming mechanisms has materialised and an unexpected outcome has resulted ('*Software-Specific Cases*'). In the case of the former, while the law of mistake may potentially apply, there is nothing exceptional and wholly orthodox principles of law apply. Whereas in the case of the latter, the application of the law of mistake to this particular class of contracts may raise interesting issues. Software-Specific Cases are the focus of this article, and not the well-trodden ground of Orthodox Cases.

In the case of Software-Specific Cases, just as the objective theory of contract can be extended to cover such contracts, the law of mistake can also be applied with slight adaptation. The law of mistake may be invoked where there are any unintended outcomes created by the software. In such a case, it may be argued that the software, in executing the orders of the user, has made a mistake as to what the terms of the contract were intended to

[53] *Digilandmall* [2005] 1 SLR(R) 502.

be. As previously mentioned, this may arise due to a bug in the software, a defect in the hardware, or a design fault.

Unilateral Mistake

A unilateral mistake arises when when the software of only one of the contracting parties acts in an unintended or unforeseeable manner. To establish that there has been a unilateral mistake, the party seeking to set aside the contract must show that: 1) the unilateral mistake was made relating to the terms of the contract (and not the surrounding facts); 2) the mistake was of a fundamental nature; and 3) the other party must have had actual knowledge or been wilfully blind to the mistake. The effect of establishing unimateral mistake is to render the contract void *ab initio* (i.e. as if it never existed).[54]

Going through each of these requirements in turn, in Software-Specific Cases, whether the first two requirements are satisfied would turn on the specific facts of each case. The contracting software can make mistakes both as to the terms of the contract and as to the surrounding facts. It is not uncommon for contracting software to access publicly available information on the internet to help it make decisions. Errors may arise both from the inaccuracy of the information collected and the way the software processes such information. As to whether the mistake was of a fundamental nature, the assessment remains unchanged whether a human or software is forming the contract.

With respect to the third requirement, in ascertaining whether a mistake has been made, the non-mistaken party must look at the representations made by the software of the other party. Under normal circumstances, a non-mistaken party is entitled to rely on the objective intention of the mistake party as the latter's true intention. The subjective intention of the mistaken party does not matter. However, where the non-mistaken party has actual knowledge of the mistake or displays wilful blindness, the doctrine of mistake at common law means that the non-mistaken party can no longer rely on the objective intention of the mistaken party.[55] In other words, the non-mistaken party is entitled to presume that the mistaken party intended what can be objectively inferred from the representation his software makes. However, this presumption is rebutted where he knows that the mistaken party had not intended to enter into the contract on those terms. In Software-Specific Cases, since the mistaken party has chosen to use software rather than express its intention directly, we can only rely on the representations made on his behalf by the software. The subjective intention of the mistaken party does not matter in this context. A non-mistaken party will only receive the objective intention of the mistaken party, given through the software, and thus, should be able to rely on it.

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54 *Smith v Hughes* (1871) LR 6 QB 597.
55 *Digilandmall* [2005] 1 SLR(R) 502 at [39]-[51].

It is noted that a problem arises with the third requirement because it could theoretically never be satisfied in any case where a non-mistaken party was using contract forming software. It is artificial to say that a software can possess the necessary actual knowledge or display wilful blindness. However, there is no reason to put the non-mistaken party in a better position simply because he uses software to contract. Rather, it is arguably fairer to adopt the position on constructive knowledge in the doctrine of unilateral mistake in equity and provide relief for the mistake where the non-mistaken party can reasonably be expected to discern that a mistake has been made. Just as the mistaken party must bear the risk of his intention being misconstrued if he uses software, the non-mistaken party must bear the risk of not being able to detect that he has received wrong information if he uses software.

A further problem arises when we consider that the effect of mistake is to render a contract void rather than voidable, which may potentially affect the rights of numerous innocent third parties, given the scale and rate at which software may form contracts. As noted above, given that contract forming software may require very little human input, they are not constrained by the pace at which humans can work and may process contracts at a speed unthinkable for a human.[56]

It is these two problems that militate towards the application of the doctrine of unilateral mistake in equity rather than the doctrine of unilateral mistake at common law.[57] While the latter doctrine requires the non-mistaken party to have actual knowledge of the mistake or wilful blindness, the former doctrine accepts a lower standard of constructive knowledge.[58] Further, the effect of a finding of unilateral mistake in equity is to render a contract voidable but not void.[59] This means that the contract would stay in force and subsist until the mistaken party evinced an intention to rescind the contract.[60] This position differs from a finding of unilateral mistake at common law, which renders a contract completely void *ab initio*, as if it never existed.[61]

It is submitted that even if the doctrine of mistake in equity does not apply to all cases, it may certainly be argued that it should apply in cases of contracts formed by software. There are two main reasons for this: 1) the requirement of actual knowledge or wilful blindness in cases of unilateral mistake is fundamentally at odds with the use of software in contract formation, since the software is incapable of either mental state. Rather, constructive knowledge is more defensible on the ground that a party who chooses to use software to

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56 Lunden, above, n 26.

57 The doctrine of unilateral mistake in equity no longer exists in English law since the decision of the English Court of Appeal in *Great Peace*. Hence, up to this point of the article, all references to 'mistake' have been to the doctrine of mistake at common law. In *Digilandmall*, the Singapore Court of Appeal consciously decided to depart from the English position in *Great Peace*, choosing to retain the doctrine of mistake in equity. See *Digilandmall* [2005] 1 SLR(R) 502 at [68] and [83]. For arguments as to why the doctrine of mistake in equity can and should be retained or even fused, see Andrew Phang, 'Controversy in common mistake' [2003] Conv 247; and Yeo Tiong Min, 'Unilateral Mistake in Contract: Five Degrees of Fusion of Common Law and Equity' [2004] SJLS 227.

58 *Digilandmall* [2005] 1 SLR(R) 502 at [53] and [80].

59 *Associated Japanese Bank (International) Ltd v Credit du Nord SA and another* [1989] 1 WLR 255 at 266.

60 *Associated Japanese Bank (International) Ltd v Credit du Nord SA and another* [1989] 1 WLR 255 at 266.

61 *Great Peace Shipping Ltd v Tsavliris Salvage (International) Ltd* [2003] QB 679 at 707-708; [2002] EWCA Civ 1407 at [90].

contract should bear the risk of the software being unable to tell that the other party has made a mistake; 2) the effect of the contract being voidable rather than void provides the necessary contractual certainty and protection of third parties[62] that is required for the kind of high-volume contracting normally done by such software. The consequences of, for example, a noticeable mistake in the software code on the Amazon website has the potential to affect millions of innocent third-parties who would suddenly, through no fault of their own, find that they did not legally own the goods they had purchased.

The outcomes generated by applying unilateral mistake are economically efficient. When the mistake is obvious, imposing a burden on the non-mistaken party to notify the mistaken party is more efficient than requiring the mistaken party to continuously check on the performance of his software. Such a high level of precaution and monitoring is likely to be expensive and inefficient. Where the mistake is not obvious, it is more economically efficient to impose the burden on the mistaken party to verify that the contracts arranged by his software are consistent with his intention. Otherwise, an immense burden would be placed on the non-mistaken party to constantly verify every innocuous contract manually with the mistaken party, depriving the non-mistaken party much of the efficiency associated with using software. All things considered, this approach (*viz.* applying the doctrine of mistake) has greater certainty as it apportions liability an objective basis of the obviousness of the mistake. If there is no obvious mistake, a contracting party can be confident in the validity of the contract.

At this point, it may be noted that some parallels may be drawn between the test of 'obvious mistake' raised here and that of 'obvious agent malfeasance' referred to above, text at n 20. Indeed it is possible that both tests may produce the same result in most cases. The two tests are similar in that they apply an objective standard to determine whether the counterparty to the contract should have noticed that the software was acting in a way that its user could not have intended. However, the law of mistake may be viewed as perhaps more intuitive and reflective of reality, in that it does not have to rely on an analogy to agency where the core feature of an agent (independent and separate legal personality) is not present.

A few additional points about applying unilateral mistake in equity should be noted. First, the definition of 'fundamental mistake' is wider for a mistake in equity than for mistake at common law.[63] However, this may not necessarily be a problem as the doctrine of mistake in equity provides the courts with the flexibility to achieve a just outcome.[64] Second, for unilateral mistake in equity to be established, the mistaken party must show an element of impropriety on the part of the non-mistaken party. Again, this is easily satisfied as the 'conduct of deliberately not bringing the suspicion of a possible mistake to the attention of the mistaken party could constitute such impropriety.'[65] It is noted that it must be possible for the 'impropriety' in the present case to be constructive in nature, for otherwise a non-

62 Andrew Phang and Goh Yihan, 'Chapter 10: Mistake' in Andrew Phang, ed, *The Law of Contract in Singapore* (2012) at paras 10.069-10.070.

63 *Frederick E Rose (London) Ltd v William H Pim Junior & Co Ltd* [1953] 2 QB 450 at 460.

64 *Digilandmall* [2005] 1 SLR(R) 502 at [54]. Also see Lee Pey Woan, 'Unilateral Mistake in Law and Equity- *Solle v Butcher* Reinstated' (2006) 22 JCL 81.

65 *Digilandmall* [2005] 1 SLR(R) 502 at [80].

mistaken party would gain an unfair advantage through his choice to use contract forming software as well.

Finally, it is noted that the doctrine of unilateral mistake in equity has no application where a case falls within the doctrine of unilateral mistake at common law. In such a situation, there 'will be no room for equity to intervene.'[66] This is a problem with the law of mistake itself, as it produces outcomes which may be considered to be unfair. For example, where a non-mistaken party possesses actual knowledge of the mistake, the contract may be void *ab initio*. However, where the same party only has constructive knowledge of the mistake, the contract may be voidable. From the perspective of an innocent third party who possesses the goods that supposedly passed under the void/voidable contract, the state of mind of the non-mistaken party is an absolutely irrelevant consideration to whether it is fair for him to retain title to the goods.

In Software-Specific Cases, a similar form of injustice may arise in that a non-mistaken party who uses contract forming software can at most have the contract rendered voidable. However, if the same party does not use such software, the contract may be rendered void if that party had actual knowledge or willful blindness as to the mistake, rather than constructive knowledge. Again, there seems to be no good reason justifying such a difference in the consequences faced by an innocent third party. This is perhaps one of the drawbacks to applying the law of mistake in Software-Specific Cases; the inherent problems in the law of mistake will affect the resolution of such cases as well.

Mutual Mistake

Statistically speaking, in Software-Specific Cases the probability of the software of both contracting parties simultaneously malfunctioning and making a mistake as to the terms of a contract, while still forming the contract, must be a very low one indeed. Nevertheless, in the rare situation where mutual mistake does arise, standard contracting principles dictate that no contract was ever formed and that the contract should be void *ab initio*.[67]

Common Mistake

In Software-Specific Cases, intuitively, it would seem that the probability of the software of both contracting parties simultaneously malfunctioning and making the exact same mistake in the contract forming process must be even lower than the cases where the both software make differnet mistakes, or where only one software makes a mistake. However, there is a possibility that the two contracting parties may in fact be using the same software for contract formation. This situation may arise for example, where the parties use a common online platform to engage in a peer-to-peer transaction. In such a case, a single malfunction of the

66 *Digilandmall* [2005] 1 SLR(R) 502 at [80].

67 *Raffles v Wichelhaus* (1864) 2 H & C 906; 159 ER 375. Also see Phang and Goh, above, n 62 at paras 10.233-10.236.

software running the online platform may well result in a common mistake as to fact or law. It would appear that a straightforward application of the general principles of common mistake would suffice in such situations.[68]

It must be remembered that the analysis of the three kinds of mistake in this article relate to Software-Specific Cases, where a dispute arises precisely because the risk of using of 'active' contract forming mechanisms has materialised and an unexpected outcome has resulted. There is nothing preventing the general principles of mistake from applying normally in Orthodox Cases where the use of software in the contract forming process is not a material point of the dispute.

Conclusion

Contracts formed with the use of software are likely to be increasingly pervasive in light of the digital economy. Consequently, software can also be expected to exhibit greater autonomy and take on increasingly complex transactions and contract negotiations. It is important that a legally coherent, fair, certain and economically justified approach be taken to regulate such contracts. The article has discussed the difficulties faced in attempting to fit contracts formed with the use of software into the existing framework of the Objective Theory of Contract. It considered three proposals to solve the Contracting Problem. The 'Mere Tools' Theory was ultimately rejected due to its artificiality when applied to 'active' contract forming mechanisms. The Agency Approach appeared promising, but was found to be unworkable due to the difficulties with giving Electronic Agents separate legal personality and/or removing the internal aspects of the law of agency.

The Extended Objective Theory of Contract is the only proposed theory which can solve the Contracting Problem. It merely requires a logical progression of the common law to accept that parties may agree in advance to accept any contract entered into by the software they have chosen that is within pre-set parameters. The common law is no stranger to gradual and logical development over time and this is but the latest in a long line of developments. This article has traced the history of the allocation of the risks of contract formation by the law of contract (above, text following n 8). It has found that common law has constantly adapted to fairly allocate such risks whenever new technologies were adopted by the commercial world. In Software-Specific Cases, the law of mistake may be used together with the Extended Objective Theory of Contract to achieve an approach which does not impose undue burdens on users and which promotes commercial certainty. It achieves the desired balance by placing the risk of software failure on the party using the software, except where it would unreasonable for the other contracting party to take advantage of a clear mistake. Such an approach is simple, intuitive, fair, and promotes commercial certainty when applied to contracts formed by software.

[68] Phang and Goh, above, n 62 at paras 10.090, 10.112 and 10.113.