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Developing and Evaluating Digital Creativity Support in Google Docs for Journalists

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Although journalism is classified as one of the creative industries, there is little bespoke digital support for creative thinking by journalists. To fill the gap, this paper reports new research that led to the implementation and first evaluation of JUICE, a new digital prototype to support creative thinking by journalists during the early development of news stories. Emerging from a user-centred design process, JUICE is implemented as a simple Add-on Sidebar and Dialog Box in Google Docs that a journalist can invoke when developing news stories. Interviews with experienced journalists were used to elicit 6 strategies that JUICE uses to guide its users to generate different angles on news stories using creative information searches and interactive creativity support. In this paper we describe the information search algorithm and new interactive support to create news stories with one of these strategies – the individual human angle on the story – then report a first evaluation of JUICE implemented with the algorithm and support during its use by journalism students. Results revealed that most of these student journalists were able use JUICE to generate new news stories with individual human angles in a short period of time, but still used established web search tools to collect more detailed information about the angle in order to write the story. Journalist feedback was used to improve the usability of JUICE and design new interactive features.

Journalism; Digital Creativity Support; Human-Centred Creative Cognition; Formative Evaluation.

1. INTRODUCTION

The last decade has seen new forms of interactive digital support for human creativity emerge for use in creative industries, such as in film and television (Alaoui et al. 2015, Honauer & Hornecker 2015), and non-creative industries such as in manufacturing (Zachos et al. 2015) and the biological sciences (Wu et al. 2011). Development of these tools has been based on different creativity paradigms, from multi-sensory stimulation (Baas et al. 2008) and data visualisation (Wu et al. 2011) to information search and discovery (Kerne et al. 2011), and tool evaluations have revealed their effectiveness in diverse professional work settings (e.g. Zachos et al. 2013). However, although journalism is classified as one of the creative industries, and information search is an important activity when creating news stories, there is little digital support for journalists to think creatively during information search to develop novel news stories.

This paper reports research that led to the implementation and first evaluation of one new form of digital support for creative thinking by journalists – support that directs journalists to use information search and idea generation strategies associated with more experienced journalist behaviour. The digital support was developed to use existing creative search algorithms that parse, make sense of and expand natural language terms (Zachos et al. 2015), and refined using user-centred design techniques that sought to embed this creativity support in the work practices and tasks of journalists. The result was JUICE (*the JoUrnalIst Creative Engine*), an Add-on Sidebar and Dialog Box to Google Docs that delivers targeted and interactive creativity support for journalists. A journalist who is working in Google Docs can, at any time, open and use the Sidebar to select story elements with which to seed and invoke different creative search strategies and review creative recommendations generated by JUICE, then import selected recommendations directly into the story text in the Google Docs editor. As such, JUICE offers a new form of interactive digital support for creative thinking that is embed-

ded in some of the daily work tools and practices of journalists.

The remainder of this paper is in 5 sections. Section 2 reviews related digital tools in journalism, linguistic creativity, and interactive creativity support. Sections 3 and 4 describe the user-centred process applied to design a first JUICE digital prototype, and the new interaction design and creative search algorithms that resulted from this process. Section 5 reports the method and results from a qualitative first evaluation of JUICE with journalism students – results that revealed that most of these trainee journalists were able use JUICE to generate news stories with individual human angles in a short period of time, but chose to still use established web search tools to find and collect more detailed information about the selected angle, to write the story. The paper ends with a discussion of these results, and outlines future plans to evolve then evaluate future versions of JUICE, and to roll it out in different news environments.

2. RELATED WORK

The research adopted Sternberg's (1999) definition of creativity – the ability to produce work that is novel and appropriate to the task – as prototypical of those reported. It also adopted the American Press Institute's definition of journalism as the process of gathering, assessing, creating and presenting news and information (API 2016). Therefore, the research undertaken in this paper defined creative journalism that is supported by digital tools as the generation and presentation of information that is both useful and new to the journalist and the news consumer.

There have been surprisingly few bespoke digital tools to support creative thinking by journalists. As a workaround to this gap, some journalists have adapted general-purpose, standalone search tools to support the development of news stories. Examples of these tools include *import.io* and *www.social-searcher.com*, both web-based tools that implement keyword searches of multiple social media channels such as websites and Twitter, present comparative results, and refine subsequent searches with extracted keywords and selected channels. However, neither tool is tailored to the tasks of journalists, only support syntactic keyword searches, and do not explicitly support idea generation during story development. Some bespoke digital journalism tools that exploit artificial intelligence techniques have been reported. For example *Alchemy* API (2016) has been applied to support journalists to make sense of unstructured natural language data with end-user applications and deliver human insights using advanced text analysis and visualisation techniques, and the *STEAMER* prototype automatically searches large text/video databases using algorithms to detect sentiment in news content, categorize news and lifestyle content, and detect events and trending topics. However, neither explicitly support computational creative searches of news information nor human creative thinking with this information by journalists. The *NewsReader* research prototype also combines text analysis and artificial intelligence techniques to build structured event indexes of large volumes of financial and economic data for decision making from news content (e.g. Minard et al. 2015), but its focus is structured decision support rather than early creative search or new idea generation. Major news organisations have also developed bespoke digital news search tools using advanced text analysis that are not in the public domain, and our analysis of them reveals no explicit digital support for journalist creativity.

Most existing research to develop new forms of interactive digital support for human users to generate creative outcomes has been targeted at domains in which people are trained to have creative skills, for example the performing arts, music, and film and television (e.g. Alaoui et al. 2015, Honauer & Hornecker 2015). Examples of this digital support include *StoryCrate*, a collaborative editing tool developed to drive users' creative workflows within a location based television production environment (Bartindale et al. 2013) and *Trigger Shift*, which appropriated commercial information technologies into performance art in theatre (Schofield et al. 2013). Studies of some of these digital tools have been shown to support creative thinking by their users (e.g. Jain et al. 2015). Although less widely implemented, digital creativity support has also been developed to support creative thinking in science and engineering, for example in the forms of new table top visualizations to support biological discoveries (Wu et al. 2011) and social media to support collaborative creativity in education (Aragon et al. 2009).

To align with the American Press Institute's definition of journalism that includes gathering and creating news and information, our research adopts Kerne's framing of creativity as an information discovery process that emphasizes idea generation over information finding (Kerne et al. 2008), and exploits the searching and browsing capabilities of digital technologies to support information finding and idea generation based on natural language processing. Examples of existing creativity support tools that exploit such framing include *CombinFormation* (Kerne et al. 2008) and *TweetBubble* (Jain et al. 2015). Such manipulation of natural language expressions to discover information that triggers idea generation is pivotal to such tools, and different forms of linguistic creativity have given rise to new computational mechanisms for creative search and generation, for example creative search engines for dementia care (Zachos et al. 2013) and

software service design (Zachos & Maiden 2008) and the *MEXICA* model of automatic creative storytelling (Monfort et al. 2013). However, few of these digital tools that compute possible creative outcomes are designed to present these outcomes to end-users to stimulate their cognitive creativity.

Moreover, our recent experiences with digital tools to support creative professional work have revealed the need to integrate this digital creativity support into daily work practices, to avoid additional cognitive load and support pain-free exploration and experimentation with the tools (Greene 2002). For example the *Risk Hunting app*, a digital tool that provides creativity support to employees on production lines to resolve health-and-safety risks in a manufacturing plant creatively (Zachos et al. 2015), was discovered to be more effective when it was integrated tightly into daily work practices. The app was designed to replicate the paper-based process to be familiar to employees, who were then able to use it for daily risk recording when the creativity support was not required, and use of this support delivered not only guidance for creative thinking but also increases in productivity through use of automatically-generated ideas with which to resolve risks (Zachos et al. 2015).

However, the published creativity support tools that are available for use were not designed to fit the work practices of journalists. Indeed most, such as Combinformation (Kerne et al. 2008) and *TweetBubble* (Jain et al. 2015) are general-purpose and search for information available to Internet search engines. A smaller number of domain-specific creativity support tools have been adapted to fit to work practices of specific domains, for example the *StoryCrate* tool for television production (Bartingdale et al. 2013), but none have been developed to support journalism tasks. The resulting gap highlights a need for a new creativity support tool that searches for relevant news information and is adapted to the needs and work practices of journalists.

To conclude, although there is reported use of advanced digital search tools by journalists, these digital tools neither fit to the daily work practices and tools of journalists, nor implement search strategies associated with generating creative angles on news stories. The limited but successful uptake of digital tools to support human creativity in other creative industries reveals one possible form of new digital creativity support in journalism, as long as these tools are integrated into the tools and practices of daily professional work. Indeed, successful creativity support tools are expected to support pain-free exploration and experimentation to promote active learning and discovery (Greene 2002), so one outstanding challenge for interaction designers is to deliver effective digital support for creative thinking that is embedded seamlessly in the practices of different professions such as journalism.

3. THE USER-CENTRED DESIGN PROCESS

The digitalization of the production and distribution of news, and subsequent new patterns of reader behaviour and fragmentation of audiences, have rendered news businesses uncompetitive (Currah 2009). Declining circulations, rising costs and loss of advertising revenue to non-editorial search engines and social media have resulted in staff reductions, content syndication and centralisation of core services (Sjøvaag 2014). Work processes in traditional newsrooms are held in check by the conservational attitudes of journalists who, if their jobs are at risk, are unlikely to change practices (Ekdale et. al. 2015). As a consequence journalists tend to focus on only a few available information sources and achieve only moderate success in their search efforts; indeed, the telephone remains an important research tool for many (Machill & Beiler 2009), and the demands in daily production are often so high that journalists can seldom develop new creative practices (Witschge & Nygren 2009).

Against this backdrop, our team undertook an 8-week user-centred process to design and implement a new digital prototype to support creative thinking by journalists. The process began by undertaking semi-structured interviews with domain experts to discover the digital tools that journalists currently use and the constraints and limitations of these tools. These domain experts were the managing editor and technical leads at London's Bureau of Investigative Journalism, a reporter at digital business news outlet Quartz, a freelance data scientist working with BBC News Labs, and a freelance journalist and entrepreneur developing new forms of digital support for journalists. The interviews revealed that word processing tools such as Microsoft Word and Google Docs are preferred to bespoke news content management systems for early story development because of their familiarity, flexibility and higher number of useful features. Speed was identified to be an important factor in news journalism, and journalists need to work quickly and need to maximise the support available at minimum effort. Therefore, to build a first prototype, the team investigated how to design and implement the digital support for creativity within one such daily work tool – Google Docs – to support journalist creativity without the need to use other tools. To deliver this support effectively, the team decided to design a new Google Docs Add-on Sidebar that was developed with a set of paper-based then digital wireframes, an example of which is shown in Figure 1. These wireframes were validated informally using presentations to both individual journalists and one group of over 20 news journalism digital experts. Different versions of a first interactive prototype of the Sidebar were then tested with students in journalism, which led to fur-

ther refinements and new features that were operationalised by a small team of interaction designers.

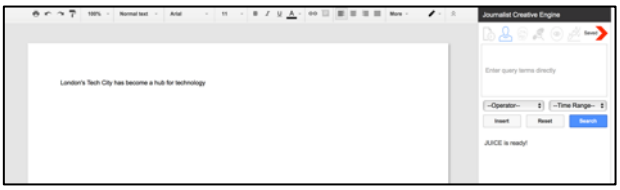

Figure 1: *One example digital wireframe on the Add-on Sidebar validated during the design process*

In parallel, the team ran semi-structured interviews with 6 experienced journalists and 2 leading digital experts in journalism to elicit strategies that these journalists use to explore and write creative angles on news stories, then validated the elicited strategies with other experienced journalists to extend and refine the strategies set. The interviews revealed 6 discrete strategies that were reported as effective for developing creative news angles:

(i) **Individuals**: creatively explore different human angles in a news story based on the different people and roles associated with the story;
(ii) **Causal**: creatively explore the background events that underpin a story to discover a new angle to the story from its background;
(iii) **Quirky**: creatively explore unusual or comical information about a story as a means of using wit to report serious news;
(iv) **Quantifiable elements**: creatively explore numerical and quantified information about a news story in order to back it up with evidence in new and useful ways;
(v) **Ramifications**: creatively explore information about the consequences of events and actions related to a news story, to generate new and useful stories about future consequences;
(vi) **Data visualizations**: creatively explore different data sets and visualisations to generate new and useful ways about how to display information in a news story to encourage human insight.

Subsequent presentation of these strategies by the research team to audiences of journalists revealed little surprise, indicating that these 6 strategies are broadly understood if not explicitly codified in the profession.

Each of the 6 strategies was then designed in the form of a computerised algorithm to search for, retrieve and present news information as recommendations to stimulate journalists to create new story angles that instantiate the strategy. To implement a first digital prototype of potential value to journalists, the team implemented 1 of these 6 strategies with full software support, to explore **individual** human angles in a news story based on the different people and roles associated with the story.

4. THE JUICE DIGITAL PROTOTYPE

The digital prototype that resulted from the user-centred design was called JUICE – the *JoUrnalIst Creative Engine*. JUICE is currently composed of 4 key software components depicted graphically in the architecture in Figure 2: (i) the interactive Sidebar and Dialog box that deliver retrieved and structured information to the journalist to stimulate creative thinking within the Google Docs editor; (ii) the JUICE creative search service that manipulates text from the Google Docs editor to generate search queries that form each input to the 6 implemented creative search strategies; (iii) the separate Juicer prototype news aggregation service, available from the BBC, which searches over 470 primarily English news sources using creative search queries generated by JUICE; (iv) the Twitter API, which searches for and retrieves more recent twitter content also using the same creative search queries generated by JUICE. JUICE also invokes software services to retrieve information from other online sources such as Wikipedia, as part of the creative search service.

A journalist interacts initially with JUICE through the single Add-on Sidebar on the right side of a Google Docs document editor. Due to this technical implementation the Sidebar has a fixed width, but can be scrolled within the editor to present more information that can fit at any time on the editor page. Moreover, to present retrieved information to the journalist without needing to open another application, JUICE also implements a Google Docs Dialog Box inside the editor. JUICE does not have any other interactive software components.

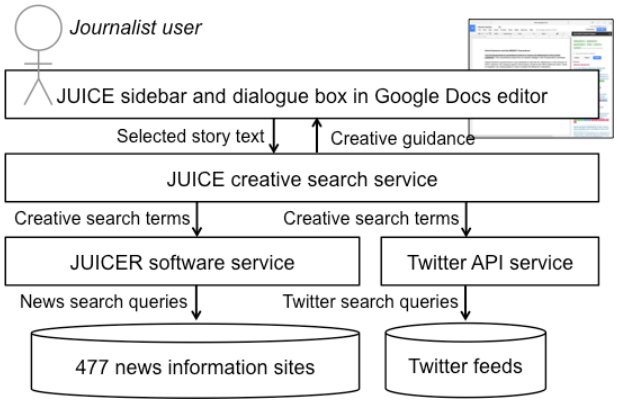

Figure 2: *The JUICE software architecture, components and information sources*

Next we describe and demonstrate how a journalist uses JUICE to develop new and creative human angles on a story about the EU referendum to take place in the United Kingdom in the summer of 2016 using the **Individual** human angles strategy described earlier. Figure 3 depicts, on the left side, an outline of a new news story in the Google Docs editor and, on the right side, the JUICE Sidebar. At any time, the journalist can highlight any text in the

story – in this example, the first sentence that describes the trigger to the story: *the UK Government is committed to hold an in versus out referendum in the current parliament*) – then click the *Insert* button in the Sidebar.

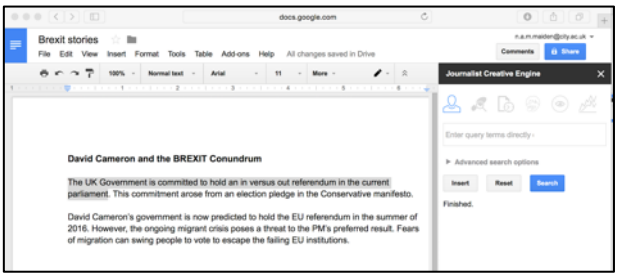

Figure 3: *Development of a new story about the EU referendum vote in Google Docs opened with the empty JUICE sidebar*

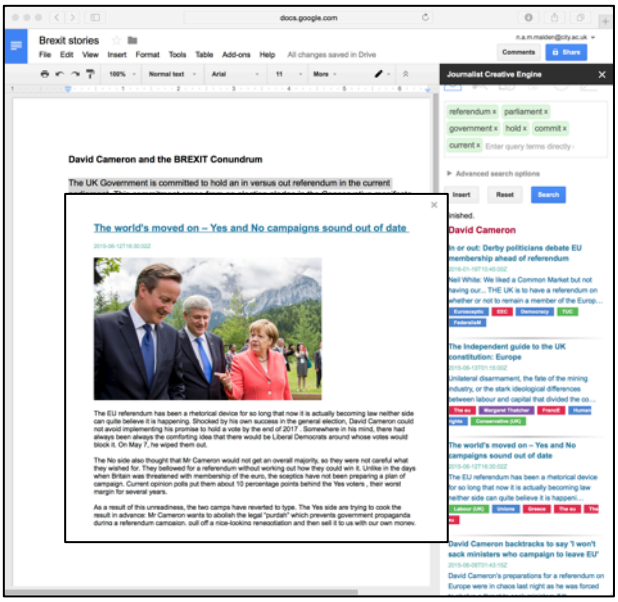

Figure 4: *JUICE showing creative search results retrieved for the inserted text (about David Cameron) in the sidebar, and one story in the opened dialogue box*

The JUICE creative search service manipulates the inserted text automatically to generate search query terms that form the input to the creative searches – terms depicted in green at the top of the sidebar in Figure 4. The journalist can edit and delete these terms, as well as add new ones, before clicking the *Search* button to invoke the Juicer and Twitter software services to retrieve information using the query terms from news sites and Twitter feeds. In our example, the JUICE creative search service parses the input sentence to extract query terms that include stem nouns such as *parliament* and *referendum*, and stem verbs such as *commit,* which are displayed to the journalist in green at the top of the Sidebar. The service also generates logical structures composed of expanded query terms with similar meaning to each stem noun and stem verb, to generate the full creative search queries. Returning to the example in Figure 4, one example of one such creative search query might be *["referendum" AND "parliament" AND ("government" OR "authority" OR "regime") AND ("hold" OR "throw" OR "have" OR "make" OR "give") AND "commit" AND "current"*]. The project team decided not to include these expanded terms in the Sidebar to avoid overloading the journalist with related query terms that might not be recognised or understood by the journalist.

Figure 4 also shows generated human creative angles from the query terms in the JUICE Sidebar – in this case about one of the more obvious of the 20 different generated human angles listed in Figure 4 – about *David Cameron*. The journalist can click on the person's name to open a description of that person in the Dialog Box extracted from the person's Wikipedia description. Unlike in traditional search websites, the Sidebar presents each creative human angle, i.e. the name of an identified person, in a random order, to encourage the journalist to explore creatively the information about these angles. The Sidebar depicted in Figure 4 presents 4 different retrieved news articles about *Cameron*. To guide creative exploration, JUICE also computes and presents different colour-coded concept categories for each article at the bottom of each retrieved article that define different places, things, people and organisations associated with the article. For example, concept categories related to the articles retrieved to support the angle *David Cameron* include *Referendum* (thing), *Alex Salmond* (person) and *Bundestag* (organisation). By clicking on these categories, the journalist can add each directly to the query terms, to refine the creative search. The journalist can also click on the article name to view it in the Dialog Box shown in Figure 4 – the journalist has clicked on the 3rd article to open the article in the Dialog Box, to support further creative thinking about the selected human angle.

Other creative human angles from the 20 that were generated by JUICE are presented in the same scrolled Sidebar in Figure 5. Examples of the creative human angles include UK politician *Nicola Sturgeon*, Greek politician *Alexis Tsipras* and Dutch politician *Jeroen Dijsselbloem*. Again, the journalist can click on both the people names and articles presented in the Sidebar to explore them further, then select one or more of these angles to develop a news story about, for example, how the migrant crisis might be influencing the political careers of one or more of these individuals.

Figure 5: *Examples of the JUICE sidebar for the same creative search information, highlighting different people about which to create human angle stories*

In addition, at the bottom of the Sidebar on the right side of Figure 5, JUICE also presents descriptions of human creative angles at the level of the role – roles such as *designers* and *environmental activists* – to stimulate creative thinking using these roles. JUICE has been implemented with a database of over 60 such human role descriptions, and a random selection algorithm generates sentences to direct further creative thinking each time that the JUICE service is invoked by the journalist.

Figure 6 again shows the same JUICE sidebar, this time scrolled even further down to reveal another suggested human angle about the economist *Mario Draghi*, President of the European Central Bank. To support creative thinking about a human angle based on *Mario Draghi*, the journalist can access background information about *Draghi* from Wikipedia and view the retrieved story about him in the Dialog Box. Based on the further retrieved information, the journalist can import this information directly into the Google Docs editor as a starting point for further story development, as demonstrated in Figure 6.

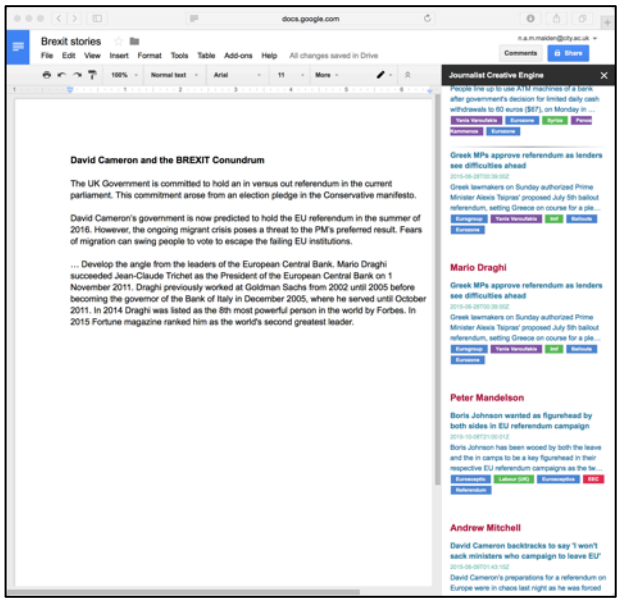

Figure 6: *The updated story about the EU referendum vote, including new information about Mario Draghi, head of the European Central Bank*

Figure 7: *Results about further depth-first information searches about Mario Draghi using Google, for example from the Wall Street Journal website*

Moreover, having identified *Mario Draghi* as the new creative angle on the story, our journalist user can then use both the JUICE Dialog Box and more traditional information sources to research and develop the story further, such as with the discovered news webpage demonstrated in Figure 7.

To deliver this creativity support, the JUICE creative search service manipulates input text to generate search queries that form the inputs to the 6 creative search strategies. The service generates creative service queries in 3 steps. The first divides the inserted text into sentences that are then tokenized, part-of-speech tagged and modified to include each term's morphological root (e.g. *committed* to *commit*) using the Brill Tagger (Brill 1992). The second applies increasingly sophisticated pro-

cedures to disambiguate each term by discovering its correct sense and tagging it with that sense using context knowledge from other terms in the query (e.g. defining a parliament to be a *legislative assembly in certain countries* rather than a *card game*) (McCarthy et al. 2004, Stevenson & Wilks 2001). The third implements different creative search strategies that expand each term with other terms that have similar meanings to the tagged sense to search for and retrieve news information (e.g. the term parliament is synonymous with the terms *congress*, *senate* and *house* are then also included in the query based on the creative strategy). These term senses are inferred automatically from WordNet, an on-line lexicon (Simpson 2005) that assigns senses to terms categorized as nouns, verbs, adjectives and adverbs. Each sense defines the meanings of a term, and WordNet organizes these senses into synonym sets that describe concepts with definitions or glosses, each of which contains a definition phrase composed of terms. The service uses this information about the disambiguated meanings of English language terms to implement 3 different creative search strategies:

(i) Synonym set expansion: each disambiguated term is replaced with its synonym set, for example the verb *commit* is replaced with the synonym set for the disambiguated sense #1 [*perpetrate*, *pull*] and noun *government* replaced with the set for the disambiguated sense #1 [*authorities*, *regime*]. The strategy expands the query to retrieve news information about each object or action described in the inserted text. For our UK referendum example, the service might retrieve news information about other forms of government committing to other types of action, for example the Canadian government's commitment to repeal laws that allow the physical disciplining of children;

(ii) Hypernym expansion: each disambiguated term is augmented by its direct hypernym. For example, the hypernym of the disambiguated term *commit* is *act*, so the revised query would include both terms. In our example, the service might retrieve news information about other forms of different government actions;

(iii) Gloss words expansion: each term is augmented with all terms in its gloss specified in WordNet. For example the sense #1 definition of the verb term commit is to *perform an act, usually with a negative connotation*. Hence the terms *perform*, *act*, *negative* and *connotation* are extracted and included in the extended query. In our example, the service might retrieve news information about taboo stories, such as about mental health and challenges to feminism.

Each time that the service is invoked, it applies all 3 strategies to match sense-tagged query terms to a similar set of terms that are passed to both the BBC's Juicer software service, to retrieve information from news webpages, and the Twitter API, to retrieve more up-to-date news information from published Tweets. The service has two different search modes – *Strict* and *Relaxed* – that the user can set using an interactive feature of the Sidebar during creative explorations. The default search mode is *Strict*, which generates queries composed of logical ANDs between all query terms shown at the top of the Sidebar. *Relaxed* mode generates queries composed of logical ORs between the terms at the top of the Sidebar, and returns a broader set of generated human angles. The Juicer service is a prototype news aggregation system that ingests over 400 English-language news sources. Whenever new news articles appear on the respective RSS feeds, the Juicer service analyses the text of the article (with the help of Wiki Data) to annotate the people, places and organisations that appear in the article text. The text itself and the annotations are stored in a format that allows for very quick and easy access via an API. Likewise JUICE applies the creative search queries to Twitter in 4 steps to discover information about individual people from retrieved news information from published Tweets: (1) it uses the Yahoo query language to search twitter for query terms such as hashtags; (2) it retrieves and compiles tweets that contain URLs to remove duplicates then records the user and tweet text; (3) it passes the set of unique URLs back into Yahoo query language to retrieve meta information such as page title and description from each webpage, and; (4) it merges the information and returns it to JUICE, to be shown to the journalist through the JUICE Sidebar and Dialog Box.

Demonstrations of this first version of JUICE's digital prototype to experienced journalists revealed its potential to stimulate creative thinking about individual human angles of stories, thus reinforcing the feedback from the earlier user-centred design process about the potential value of JUICE. However, we lacked evidence that hands-on use of JUICE could support journalists to generate creative angles on new stories. Therefore, the remainder of this paper reports results from a first evaluation of JUICE, to collect and analysis this evidence.

5. FIRST EVALUATIONS OF JUICE

We conducted a challenging evaluation with participants – postgraduate and undergraduate students at the University's Journalism Department, who each received a £10 Amazon Voucher for participating. During the evaluation, each participant worked individually for 30 minutes to write a journalism piece of 300-400 words about the current European migrant crisis in a Google Docs editor extended with JUICE and the Google search webpage in a separate tab of the web browser. An

experienced professional journalist in the department formulated the task to be prototypical of the length of such pieces, and challenging but realistic in terms of the time available to write the piece.

5.1. Formative Evaluation Method

The instruction given to each participant was:

> *"You are working for the Independent newspaper. The editor wants a 300-400 word piece that revisits the Greek migrant crisis story that broke in spring 2015. The story should feature one or more unusual angles based on individuals associated with the crisis."*

Each participant undertook the task as an individual in a quiet office on a desktop computer with a fast and reliable Internet connection. The computer had been set up with the Google Docs editor and JUICE Sidebar open in one browser window, and the separate Google search webpage in another window. At the start of each evaluation, the participant sat at the desktop computer and the experimenter asked him/her to confirm that s/he was familiar with the desktop computer hardware and software, and the Google search website and Docs editor. The participant then watched a 3-minute video that described JUICE and how to use the JUICE Sidebar to discover new human angles on news stories. At the end of the viewing, the experimenter asked whether each participant understood JUICE and to ask follow-up questions about it if needed that he then answered until the participant had received answers to his or her satisfaction. The experimenter then read the journalism task out loud to the participant and answered any clarification questions that were asked.

During the task, each participant had access to the time remaining to complete it via a clock on the desktop of the computer. The experimenter remained in the office with the participant, sat out of line of sight, but available to answer further questions from the participant. At the end of the task, the experimenter asked the participant to complete a short printed questionnaire of 5 questions that requested 1-7 Likert scale responses about the perceived degree of challenge posed by the task in the time available, the perceived degrees of use of the JUICE Sidebar and Google search webpage during the task, and the perceived usefulness of the Sidebar and the Google search webpage during the task. Finally, the experimenter verbally asked a small number of questions about the source(s) for the human angle(s) for the written news piece, as well as about any problems that each participant faced during the task to use JUICE and the Google search webpage.

5.2. Formative Evaluation Results

The first participants were 3 students (S1, S2, S4) on the University's Masters in International Journalism, and 1 student (S3) on its Bachelors in Journalism. All 4 participants successfully completed the task in the time required and wrote pieces that satisfied the remit, even if some were shorter than the required 300 words. These 4 pieces are summarised in Table 1. Three of them (from S1, S3 and S4) were based on angles of individual people – for example, a fisherman, a smuggler and members of a single migrant family – indicating that these 3 participants did complete the task as required.

Table 1: *Summaries of news pieces written by the 4 evaluation participants*

Participant	Summary of participant's news pieces
S1	*A 315-word piece about the ordinary people, people such as fishermen, soldiers and housewives, who do not typically win Nobel Peace Prizes. The piece writes about the ordinary people in Rhodes saving lives – people such as Antonius Deligioris who saved 20 refugees from drowning when their boat hit rocks of the shoreline.*
S2	*A 233-word piece about Turkish people smugglers who explain that they are undertaking humanitarian work – God's work – by helping refugees across the Aegean to the Greek islands. It reports the story from the perspective of an unnamed 21 year-old smuggler.*
S3	*A 260-word piece about the fears and concerns held by the right-wing anti-austerity Independent Greeks party, and the views of its leader about the future of Greece as terrorism fears can hit its tourism industry.*
S4	*A 266-word piece about 2 angles that have humanised the migrant crisis and drawn people's attention to it. The article described the consequences of the actions of a Hungarian camerawoman filmed tripping a 7 year-old refugee, and a family that lost its cat during the flight from ISIS, which was found in Norway.*

Participants' quantitative responses to the 5 questions in the post-task questionnaire are reported in Table 2. All 4 participants rated the task with a 3 or 4 – moderately challenging – and 3 of the participants reported using the Google search webpage more than JUICE and found the Google search webpage more useful than JUICE for the task. Participant S3 experienced technical problems with JUICE during the task that required the experimenter's intervention, and also rated JUICE lowest on levels of use. In contrast, S2 rated JUICE to be more useful and more used than did the other participants. All 4 participants rated JUICE in the range 3 to 5, ratings indicating that it was more or less useful.

***Table 2:** Participant's numeric responses on 1-7 Likert scales to the 5 post-task questions – higher scores indicate greater challenge, use and usefulness*

Participant	Challenge	Use of Google	Use of JUICE	Google Usefulness	JUICE Usefulness
S1	*4*	*6*	*3*	*7*	*3*
S2	*3*	*4*	*5*	*4*	*5*
S3	*3*	*7*	*2*	*7*	*3*
S4	*3*	*6*	*3*	*6*	*3*

The content of each news piece and the source of each human angle were analysed. The most positive about JUICE, participant S2, wrote a piece about smugglers who describe their activities to transport people across the Aegean to the Greek islands as humanitarian. She used JUICE to search for human angles based on terms such as *Greece*, *migrants* and *refugees*, and JUICE's first presented human angle was about a people smuggler who claimed that he was doing God's work, extracted from an article reported in the *Irish Independent*. This automatically generated angle was used directly to provide the theme for the written piece – although the participant also reported that JUICE recommendations about *George Clooney* had offered a valuable alternative human angle on the story. The participant reported that finding creative and unusual angles was sometimes difficult in journalism tasks, and JUICE appeared to have potential to be helpful for this purpose. She singled out specific JUICE features, such as to add new query terms directly to the creative search, as valuable. The participant also proposed new features of JUICE, for example to save retrieved news articles to return to later, and to integrate with news digests.

Participant S1 was less positive than S2 about JUICE, and although JUICE did direct him to create the article about unsung humanitarian heroes, he reported using the Google search webpage more during the task. During his first creative searches with JUICE, S1 used different human roles rather than individuals presented by JUICE, such as the roles presented at the bottom of the Sidebar on the right side of Figure 5, to stimulate creative thinking. He first explored one of the presented roles – *photographer* – and entered the term into JUICE, but was not inspired by the search results. He then explored a second presented role – *philanthropists* – to discover and create the Nobel Prize theme for the migrant story. Based on this creative inspiration from JUICE, he then used the Google search webpage to generate more specific content for the piece. After the task the participant reported that JUICE had generated a disproportionately higher number of different human angles about politicians, and identified one desirable new feature – to be able to refine creative searches using selected human roles presented to the user by JUICE.

Participant S4 produced an article about 2 angles that humanised the migrant crisis in order to draw people's attention to the crisis. Again, JUICE was perceived to be helpful, and supported this participant to create the second human angle for the story, about the family that lost its cat fleeing from Isis. However, although it was reported to provide effective support for idea generation, and the story preview feature shown in Figure 4 was reported to be useful, the participant reported that JUICE was less effective for gaining direct access to relevant articles that JUICE retrieved to generate the creative angle. And although having generated new and creative story angles with JUICE, the participant reported that some of the generated angles and their ordering in the Sidebar were too random, which impeded the participant's understanding of JUICE's logic for retrieval and presentation.

In contrast, participant S3 reported a lower level of use of JUICE than did the other participants – a rating that was consistent with the experimenter's observations of the participant, several interventions that the experimenter was required to make, and the participant's responses to the interview questions. At the start of the task the participant experienced a usability problem that stopped her from using JUICE. Rather than use bespoke JUICE features to parse selected text from the editor to generate keywords to search with, as depicted in Figure 4, the participant directly entered longer strings of text directly into the single-keyword boxes at the top of the JUICE Sidebar, then pressed the *Search* button – behaviour which resulted in JUICE returning no matches due to the complex terms that JUICE was seeking to expand and match. After several failed attempts to generate creative human angles with JUICE, the participant switched JUICE's search from *Strict* to *Relaxed* mode – a change that did result in generated human angles for the input text, but the participant considered these angles to be too far removed from the input text and story. The participant became frustrated and abandoned use of JUICE, and generated the news piece using the Google search webpage. It is interesting to note that this news piece was the only one of the 4 not to make explicit references to individual people in the story.

In conclusion these evaluation results, although very preliminary, indicated that 3 of the 4 trainee journalists who had been given minimum training to use the JUICE tool, used it to create novel news pieces with individual human angles in the mandated 30 minutes. The journalists used JUICE's creative guidance about both specific individuals and more generic human roles to create these news pieces. However, although the human angles generated and presented by JUICE were used by the

journalists to create the stories, the journalists still used the Google search webpage to retrieve information with which to write the story. However, one trainee journalist did not use the Sidebar's query term feature as it was designed, and rejected the use of JUICE for the task.

6. DISCUSSIONS AND FUTURE WORK

This paper reports the design, implementation and first evaluation of a new type of digital prototype, embedded in one tool frequently used by journalists, to provide creativity support for developing news stories quickly. JUICE is now a robust digital prototype available to several news and teaching institutions to experiment with and improve. First qualitative feedback reported in this paper reveals that it can support creative thinking in short periods of time to generate novel news stories. Of course, substantially more software development, testing and summative evaluation work is still needed, but the design and evaluation work so far provides evidence for the potential effectiveness of JUICE.

Results from the evaluation have revealed several usability issues to resolve and identified new features that can enhance the tool's usability and value. JUICE is currently being extended with clearer instructions to direct users to import text from the Google Docs editor into the Sidebar prior to editing query terms in it, as well as new error-checking features to stop a user from entering query terms, such as a phrase or sentence, that are too complex. More generally, the Sidebar design will need to be reconsidered to discourage users from using JUICE as a web search engine. A new feature is being developed to provide contextualised advice to narrow, change and broaden creative searches and change search modes that is based on results returned earlier in the session, to direct the user to work more effectively with a complex search engine. The team is also adding most of the features directly requested by the participants, for example to save viewed/tagged news articles in JUICE, and to directly refine creative search terms by clicking on different generic human roles presented at the bottom of the Sidebar. The formative evaluations of new versions of JUICE supporting the **Individuals** creative angle will continue, and we anticipate developing a more usable, complete and stable version of JUICE.

The resulting, more complete and stable version of JUICE will become the focus of summative evaluations to investigate the hypothesis that use of JUICE by journalists will be associated with the generation of more creative news stories than use of existing digital tools and sources. A two-condition study will involve experienced journalists in blind rating of news stories for different attributes of a creative outcome – its novelty, its usefulness and its surprise value (Maher et al. 2013) – using Likert scales, similar to creative outcome assessment reported in Hollis & Maiden (2013). The study will investigate JUICE support for both P-level and S-level creativity. P-level creativity is the generation of knowledge that is novel and useful to the individual (Boden 1990), which for JUICE is the journalist developing a story. S-level creativity – social creativity – is the generation of knowledge that is novel and useful to wider social groups, not only the intended readership for the journalist's story, but also other journalists in the newsroom. Therefore, the study will be constructed of stories that will be written by journalists with and without the use of JUICE, each with Likert scales to indicate the perceived novelty and value of the story, which will be made available to 3 groups – a segment of the intended readership, peer professional journalists, and more experienced journalists who will bring domain and discipline expertise to rate each news story. In parallel the team will implement first versions of the other 5 strategies for developing creative news angles. The codification of support for the **Quantifiable elements** strategy is complete. In parallel, user feedback about the bias some generated creative guidance towards politicians is provoking a rethink of the information sources, such as the BBC's Juicer service, that JUICE searches, to provide wider-ranging creative sources.

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