Denouncing child manipulation to produce sexualised imagery on YouTube

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Author contributions

SG conceived the study, analysed the web data and wrote the paper. AM sourced the literature data and wrote the paper. JWE analysed the data and wrote the paper. All three authors edited the paper at a later stage.

Abstract

Over the last decade, a vast YouTube-based ‘market’ of child-produced content involving sexualised behaviour has developed. Children-performers produce videos featuring implicit sexual imagery to satisfy the demands of an adult fan base, and in exchange for a digital reward. We first report the discovery of several YouTube keywords leading to such content, outlining their remarkable interconnectedness via analysis of search trends over the last decade. Following, we investigate audience-child interactions by semantic analysis of $n=1398$ comments mined from $n=30$ videos, revealing the occurrence of collective grooming. We then demonstrate how this phenomenon is sustained and enhanced by YouTube search algorithms. Following, we propose a model framework to contextualise our findings. Finally, we propose specific amendments to the 2018 Online Harms White Paper that might tackle this phenomenon.

Our results reveal a new form of child abuse, as of yet undescribed, wherein the core features of online grooming are translated to social media, the fundamental principles of which act as a powerful incentive. Because the victim’s manipulation is enacted collectively, we believe that responsibility ultimately rests with society as a whole. The principal aim here is to raise awareness of this issue, in an attempt to kick-start discussion of its causes, implications and potential solutions.

Introduction

In the context of child abuse, the term grooming refers to a set of manipulation techniques employed by adults with predatory intent (Katz, 2013). The aim is to facilitate the breakdown of emotional barriers in children or adolescents, in order to establish an intimate and/or sexual relationship. The victim is not generally aware of the true nature of the abuser’s behaviour. Since the primary goal is for the offender to achieve a personal bond based on trust, the interaction is based on seemingly positive tones. These include overt support and encouragement, as well as the extensive use of compliments, in a general manipulative effort to be perceived by the child as a means to enhanced self-esteem. Ultimately, however, the initiation of a sexual relationship, of any kind, is expected in return.

In its online form, child grooming is a highly prevalent phenomenon. Studies indicate that up to 1 in 3 USA adolescents is the target of online enticement every year (Wolak et al., 2006; Ybarra et al., 2007). Similarly, out of 25,000 EU minors aged 9-16, 1 in 3 reports having met strangers virtually (EuKids, 2012), with 1 in 10 online encounters being followed by actual meetings. Strikingly, only 1 in 100 children who progressed to offline interactions reported feeling worried or scared, indicating significant underestimation of the risks by the victims. The latter finding also demonstrates the effectiveness of grooming strategies, whereby the offender is perceived as a non-threatening entity. Online child grooming is now known to follow a step-wise, escalating progression (Katz, 2013). Its principal aim is the exchange of sexualised media content to the benefit of the perpetrator (AIC, 2008; Choo et al., 2008). The child is usually encouraged to generate material employing webcams or digital cameras and release such content directly to the offending part. Importantly, this reconfigures the abusive interaction by conferring upon the victim the additional roles of producer and distributor (Wolak et al., 2008). Furthermore, such exchange may progress to what has been defined as “enactment fantasy” (Kloess et al., 2017), wherein the offender manipulates a child into actualising their own sexual fantasies.

Over recent years, this phenomenon has undergone a substantial paradigm shift. Whilst child grooming has traditionally occurred in chat rooms, today the principal locus of malicious luring is found on social media. Up to half of all online enticements reportedly occur on these platforms (Child Exploitation and Online Protection Centre, 2013) in an increasing fashion. Consider the social media model (SMM). This remarkable apparatus of virtual interpersonal networks is integral to modern society. At its core is the *like*, a modular unit on which a *following* is constructed through *sharing* of content and rating via *comments*. Beyond mere communication, social media essentially functions as a collective reward system via self-broadcasting. Several iterations of SMM exist based on the same founding principles (eg.: YouTube, Facebook, Instagram). Indeed, children make extensive use of this technology. A 2014 survey of 13 year old students, administered by ECPAT (End Child Prostitution, Pornography and Trafficking), has

in fact found that out of 131 subjects interviewed, 90% had created a Facebook profile before the set minimum age of 13 years. Of these, 80% reported *sharing* at least one picture daily, with up to 20% enjoying a *following* of over 1200 ‘friends’. The survey also found that 60% of students with a Facebook profile had been the target of sexual-themed comments or requests. As many as 90% within this subset reported not disclosing said predatory interactions to their parents, fearing a negative response.

Studies suggest that online sexual predators select the most suitable SMM platform by thorough assessment. Specifically, they seek the most popular medium, and one with a strong presence of minors. An additional level of selection entails targeting the most emotionally vulnerable and/or sexually curious victims (Quayle et al., 2014; Malesky, 2007) by analysing their online profile and available pictures (Kloess et al., 2017; Quayle et al., 2014), as well as tailoring their strategies to each individual child (De Santisteban et al., 2018).

Current evidence overall indicates that online child grooming is a prevalent phenomenon now also found on social media. Building on this premise, this study identifies a new form of child abuse, wherein the core features of online grooming are ran through a social media framework, the fundamental principles of which (*like, share, follow, comment*) act as a powerful incentive. We report that on YouTube, today, children as young as 6 years old generate videos featuring implicit sexual imagery, watched primarily by adults. They self-produce and release such content, supposedly of their own accord. Young girls expose their bodies by performing physical feats which, whilst based on gymnastics and yoga, clearly mimic sexual behaviour. (Fig.1A). We henceforth refer to the above phenomenon as child-produced sexualised imagery (CPSI). While this initial investigation focuses on YouTube, we do not exclude the potential occurrence of such phenomenon on other SMM platforms. A previous YouTube-based, independent report of the phenomenon already exists. This was published by the adult YouTuber MattsWhatItis, entitled “*Youtube is Facilitating the Sexual Exploitation of Children, and it's Being Monetized (2019)*”. Although the inception of our study actually pre-dates this YouTube report, we find

it useful to include it as supporting evidence to better inform the reader on the extent of CPSI.

Methods

All methods outlined here were employed to generate the results reported in this paper, and should be considered accurate as of August 2018, ie the time of data collection. Because of the highly dynamic nature of web traffic, it is not possible to exclude the occurrence of significant variability over time. This implies that, upon future replication, results may differ to an unknown extent. It is however expected that, despite such variability, the overall picture is likely to remain unchanged. It is inherently difficult to employ traditional research tools to assess an elusive Internet phenomenon such as CPSI, and the data reported here should be taken as a preliminary, representative characterisation. This is arguably sufficient for the purposes of this study, which aims to initially expose and draw attention to CPSI.

Identification of candidate CPSI keywords

At the point of discovery, a single instance of CPSI content was first identified by chance on YouTube, appearing as a search result for the term ‘cat cow pose’. This generically refers to a legitimate yoga stance, demonstrated in a very high number of YouTube videos featuring adults.

‘Cat cow pose’ was thus established as the first CPSI keyword. All other search terms reported here (Fig. 1A) were then identified systematically employing the Google Trends tool (<https://trends.google.com>). To achieve this, the term ‘Cat cow pose’ was searched for in Google Trends. The tool was configured to probe YouTube data only, encompassing worldwide traffic across all categories and spanning the widest possible timeframe, from 2008 to present. Following, the ‘related queries’ section of results was consulted to reveal additional keywords from the trend data obtained. This function displays terms also searched for by users who input the keyword examined. The top five most popular related queries (*Puppy pose, splits, cat cow stretch, frog splits* and *gymnastics*) were selected as CPSI candidate keywords. For these terms, the above search process was then repeated, selecting the first most popular related query for each as a subsequent candidate. This overall yielded the 11 CPSI search terms reported in this study.

Validation of CPSI candidate keywords

In order to establish whether the identified terms could at all lead to search results featuring true CPSI, all keywords were employed as a simple YouTube query. The results obtained were sorted by 'relevance', and the top 50 entries were then consulted. Amongst these, and for all keywords, the number of videos displaying content in strict adherence to our proposed CPSI definition was counted manually and subsequently reported as a percentage (Fig. 1B). To ensure specificity to CPSI content, the same process was repeated employing a random search query (*letter A*) as negative control.

Trend analysis

All search trend data reported in this study (Fig. 1-4) were collected employing Google Trends in the already mentioned configuration, for all CPSI keywords. The tool expresses relative 'search interest' as a function of time, normalised to maximum traffic generated. In this study, all values obtained for each term were exported in their normalised form and compiled into a single data set for trend analysis over time. A control trend (*letter A*) was also employed identically, as well as the putative trigger query '*Ice Bucket Challenge*'.

CPSI Network

The CPSI keyword network (Fig. 3) was assembled as described in the relevant section of this study, employing the Cytoscape tool.

Statistical analysis

For differential search interest analysis, normalised trend values for all keywords were pooled and subsequently split into two groups, corresponding to two broad time periods (2008-2014 and 2014-2017). The same was done for the control trend (*letter A*). Overall search interest values in each time period were then analysed by ANOVA with Kruskal-Wallis test.

To assess trend correlation over time, all normalised values for each keyword were analysed by Spearman's rank correlation. At corresponding time points, and across the entire time period investigated (2008-2017), all search trends, including controls, were compared against each other in all possible combinations.

Semantic analysis of comments

This analysis was performed by extracting $n = 1398$ comments from $n = 30$ YouTube videos strictly adhering to our proposed CPSI definition. No user information or other metrics were investigated. Their semantic content was then analysed employing the freely available Voyant Tools text mining platform (<https://voyant-tools.org/>). The Cirrus word graph depicted in Fig. 5 was directly generated by this tool and reported without any further processing.

Anonymisation and child protection

Due to the highly problematic nature of this phenomenon, which involves minors uploading to YouTube, we do not provide any direct web links to CPSI content. Additionally, any visible name of anyone involved (children and viewers, eg. in comments) was also removed.

Results

We developed this study following the chance discovery of a single instance of child-produced sexualised imagery. At present, its core features escape any existing formal classification. Therefore, we begin by providing a working definition (Fig. 1C). This was formulated strictly based on the most distinguishing properties of the first video identified by chance (not shown). We initially hypothesised that, were this not an isolated finding, our criteria may lead to the identification of a high amount of similar content.

CPSI is thus defined as any instance wherein a child (pre-pubertal age) self-generates video content featuring implicit sexual imagery, to the benefit of a web-based adult audience and in exchange for a digital reward. The latter takes the form of *likes*, *shares*, *followers* and *comments*, all key SMM components. Here, the term 'implicit sexual imagery' refers to any observable physical act which, if performed by an adult, would be reasonably deemed at the very least suggestive of sexuality. For instance performing a gymnastics stretch in which the legs are apart, with a front-facing camera angle, would be categorised as such, given the position implicitly mimics, or at least recalls, sexual intercourse. To protect the identity of children involved, and limit further distribution of such material, we elected to strictly not provide any direct links to or actual media.

Furthermore, based on the first video identified, CPSI content is by definition strictly child-

A

Keyword	Total results
Puppy pose	$16 \cdot 10^3$
Cat cow pose	$10 \cdot 10^3$
Not my legs challenge	$183 \cdot 10^3$
Not my legs	$16 \cdot 10^6$
Stretch challenge	$194 \cdot 10^3$
Gymnastics challenge	$7 \cdot 10^6$
Splits challenge	$71 \cdot 10^3$
Desafio yoga	$55 \cdot 10^3$
Cat cow stretch	$15 \cdot 10^3$
Yoga challenge	$7 \cdot 10^6$
Kids yoga	$5 \cdot 10^6$

B

Prevalence of CPSI videos by keyword

C

A **B**

YouTube search trends (2008-2017)

C

YouTube search trends (2008-2017)

produced, self-distributed, viewed legally and available free of charge on video sharing platforms (e.g. YouTube). It should be stressed that CPSI entails an absolute lack of direct adult involvement at any stage of content generation. As such, paedo-pornography and any other adult-generated material are not classified as CPSI. It is also essential to state that CPSI requires a seemingly *active* willingness to provide content on the child's part, in the absence of any direct pressure to do so by a third party.

Identification of CPSI keywords

We first sought to determine which YouTube search terms, if any, might direct users to videos that fulfil CPSI criteria, identifying 11 (Fig. 1A). When each term was searched for on YouTube, 20% (Puppy pose) to 80% (Desafio yoga) of the 50 most 'relevant' results comprised CPSI content (Fig. 1B - Aug 2018). It must be stated that these findings are highly preliminary, and likely depict but a small fraction of all CPSI keywords. We would nevertheless expect a much higher number of CPSI-related search terms to be identified upon systematic analysis. Also, these data should be considered accurate as of Aug 2018, and likely vary over time due to changes in web traffic, YouTube search trends and uploading of new content.

CPSI is a recent phenomenon

We found that our target set of CPSI keywords has begun trending in July-August 2014. We interrogated the Google Trends Tool in this respect, observing an abrupt surge of 'search interest' for most of the above 11 keywords around this time point. Over the last decade (2008-2017), the integrated average search interest for all CPSI keywords under investigation was significantly higher in the 2014-2017 window, as opposed to a control trend (*letter A*), which did not vary (Fig. 2).

This finding suggests the presence of a putative trigger event. That is, one or more distinct, co-occurring trends which facilitated the establishment of our reported CPSI search terms. Seeking to pinpoint such a trigger, we first consulted historical archives, searching for any potentially responsible, significant world events that occurred in July-August 2014. Finding no obvious correlation, we then hypothesised the trigger to be YouTube- or SMM-specific.

We thus explored several candidate 'viral' trigger terms for the above time period. This was achieved via Google Trends, by assessing correlation in trend onset time between candidates and CPSI keywords. This approach revealed the most likely trigger. The sharp rise in search interest for all CPSI keywords over time rapidly followed the primary 'viral' spread of the "Ice Bucket Challenge" phenomenon (Fig. 2C). The latter began trending exactly around July-August 2014, and was in fact one of the most prevalent SMM-based initiatives at the time. The Ice Bucket Challenge was a highly-successful digital campaign to raise awareness of motor neuron disease. As such, it enjoyed wide popularity and celebrity endorsement. Its resonance in the public eye, however, was quite short lived. Search interest fell dramatically in autumn 2014, and has since virtually disappeared. In contrast, the stark time-consistent rise of CPSI search interest, seemingly correlated to the Ice Bucket Challenge, has persisted.

CPSI: a well-structured, self-enhancing network of content

After identifying a set of CPSI search terms and describing their popularity over time, we investigated how, if at all, they influenced one another. Once again, we employed the Google Trends tool to this end.

Based on Google Trend's 'related search' function, we first assembled a simple network with CPSI keywords as nodes and search suggestions as edges (Fig. 3). The resultant graph features a high degree of closeness centrality, with the search of any one term leading to all others within three nodes. We then sought to determine whether Google Trend-reported 10-year differential search interests for each keyword could at all correlate. In all cases, our analysis demonstrated a robust, positive correlation between any two CPSI terms, quantified by Spearman r coefficient (Fig. 4). In contrast, all queries showed no correlation with a control trend (*letter A*).

Child-audience interaction through comments

We then assessed the interaction of children-performers with their adult audience through a key SMM component: *comments*. To this end, we quantified semantic recurrence in a high volume of comments ($n=1398$) extracted from 30 manually selected, strictly-CPSI videos

CPSI keyword relatedness network

● Search term
— Related search

Correlation analysis

A

16 Comments SORT BY

Add a public comment...

cool! how about a frog pose video?

4 REPLY

View 4 replies

BEST VIDEO OF CAT COW INFORMATION VIDEOS

1 REPLY

Really nice job. U know ever i love your videos and, dont worry, you was do very well dear <3

2 REPLY

I like 😊 thanks for that video keep going like this

3 REPLY

Yay ur so adorable 💜💜💜💜💜💜💜💜💜😊

3 REPLY

B

2 REPLY

3 days ago

I'll do it tomorrow. What do you want me to do?

2 REPLY

Can you do handstands ?. 😊

1 REPLY

3 days ago

Yeah of course. Didn't you watch all of my vids?

2 REPLY

Lps BUNNY so FUNNY no I havent

REPLY

(edited)

Lps BUNNY so FUNNY can you do splits?. Do splits please! With swimsuit or leggings..but but do it your back facing to the camera please!...and closer..to the camera

REPLY

2 days ago

Cool

1 REPLY

A privacy reminder from YouTube, a Google company

REMIND ME LATER REVIEW

Search

Q

SIGN IN

Home

Trending

History

BEST OF YOUTUBE

Music

Sports

Gaming

Films

TV Shows

News

Live

360° Video

Browse channels

Recommended

Video 1

Video 2

Video 3

Video 4

Video 5

Video 6

Video 7

Video 8

Video 9

Video 10

SHOW MORE

(Fig. 5). Our analysis showed that the most frequently used words were charged with positive and encouraging tones (eg *love, good, pretty*). Audience members may thus employ comments to verbally reward children for their performance. Comments may be used to make requests for very specific performances (Fig. 6), by actively stating which particular positions the child should display ("*Can you do splits? [...] do it with your back facing the camera*"- Fig. 6B) and even suggesting what they should wear ("*With swimsuit or leggings*"). Children may respond pro-actively to requests made ("*Can you do handstands?*"[...]) "*Yes of course. Didn't you watch all of my vids?*").

YouTube adaptively 'recommends' CPSI content

In order to complete our preliminary picture of the CPSI phenomenon, we also investigated the role of YouTube search algorithms. Based on user queries, the platform itself suggests which content is 'recommended', based on machine-learned search behaviour. We found that even after brief CPSI-specific search activity on YouTube (60 min), the platform responds with a remarkably tailored selection of 'recommended' content.

Discussion

In this study, we report the occurrence of child-produced sexualised imagery (CPSI) on YouTube (Fig. 1). CPSI is generated and distributed entirely by children. The vast majority of viewers, however, are adult males, who exploit SMM-based digital rewarding (views, *likes, followers*, comment). CPSI is an unprecedented occurrence, clearly, and its features may seem puzzling. Nonetheless, we argue that its existence results from the combined action of multiple well known phenomena. Existing evidence supports this notion, and aids the interpretation of our findings.

First and foremost, we suspect that the sexual nature of this content may be rooted in societal attitudes toward female beauty. Specifically, in the phenomenon of self-objectification. Modern society has undergone a progressive 'sexualisation', via commodification of standards of beauty and the ever-presence of eroticism in all spheres of public discourse (Ward et al., 2015; APA, 2007). This is especially true for women. The objectified female body has become stereotyped, purported as a mere instrument of male pleasure (Fredrickson &

Roberts, 1997). This is achieved by directing attention to specific body parts in mass media, and emphasising their sexual function, for instance via revealing garments and allusive poses (Aubrey & Frisby, 2011; Coltrane & Messineo, 2000). Over time, this portrayal style has clearly granted a default 'sexualised' status to female beauty, in other words a necessary requirement for its very definition (Daniels & Gillen, 2015; Sypeck et al., 2004).

Children thus develop in a sociocultural environment where girls are valued primarily for their physical attractiveness (Kirsch & Murnen, 2015; Dohnt & Tiggemann, 2006), a rhetoric which is strongly peer-validated (Lawler & Nixon, 2011; Clark & Tiggemann, 2006).

The phenomenon of self-objectification occurs when said standards are internalised, and individuals attempt to enhance their sexual attractiveness by conforming their bodies and looks to implicit societal parameters of 'ideal beauty' (Dakanalis et al., 2015; Slater et al., 2012; Ward & Harrison, 2005). When presenting in children, self-objectification results in their precocious development of sexualised behaviour (Duschinsky, 2013; Egan, 2013; Smith & Attwood, 2011; APA, 2007). As such, girls learn to value their body as a function of others' desires (Frederickson & Roberts, 1997; McKinley & Hyde, 1996). Several studies have provided evidence of this phenomenon in teen and pre-teen girls (Calogero, 2009; Myers & Crowther, 2007; Calogero et al., 2005; Tiggemann & Kuring, 2004; Slater & Tiggemann, 2002; McConnell, 2001; Morry & Staska, 2001; Tiggemann & Lynch, 2001) as well as younger children (6-12 years old) (Grabe et al., 2007), to a similar extent in both groups (Jongenelis et al., 2014). Furthermore, self-objectification has been shown to correlate with exposure to sexualised mass media content (Slater et al., 2016; Starr & Ferguson 2012).

Evidence suggests that female objectification has significantly deepened in prevalence and become more explicit over the years (Graff et al., 2013; Reichert & Carpenter, 2004; Krassas et al., 2001; Reichert et al., 1999). This also applies to media aimed specifically at young children, who are exposed to objectification by, for instance, dolls and kids' clothing (Goodin et al., 2011; Papadopoulos, 2010; APA, 2007). It is thought that, cognitively, self-objectification may lead to significant negative effects, such

as distorted body image, depression and low self-esteem. It follows that these processes may hinder healthy sexual development in children, and particularly girls (APA, 2007). The female gender has in fact been shown to be more susceptible to mass media influence (Allen et al., 2008; Moriarty & Harrison, 2008), displaying significantly higher levels of self-objectification/sexualisation (Calogero, 2009; Aubrey, 2006; Tiggemann & Kuring, 2004; O'Donohue et al., 1997). Girls are also more likely to fall victim to sexual exploitation online than boys (Whittle et al., 2013; Wolak et al., 2008) and our findings accordingly show that CPSI mostly affects the female gender, with girls of pre-/early-pubertal age (8-14 years old) starring in the majority of videos identified. This is empirically evident upon brief consultation of search results produced by the keywords reported. Translating the above notions onto this study, we argue that children affected by sexualisation and self-objectification are also primed to engage in CPSI. Such content, in fact, objectifies children by reducing them to an implicitly sexual physical stance.

Consequently, we hereby propose that CPSI is a new form of child abuse, one entirely native to the current digital culture. As such, we found that it strategically employs legitimate SMM rewards as a conduit for grooming of children affected by sexualised self-objectification. This yields a hybrid process that is clearly distinct from previous forms of online enticement. Critically, the abuser-victim interaction is no longer primarily established on a one-to-one basis. Instead, the key SMM components of *like*, *share*, *follow* and *comment* become the core incentives for the victim to engage. In our view, this feature of CPSI is underpinned by the wider phenomenon of online self-presentation. The theory of self-presentation (SPT) asserts that when individuals presents themselves, they attempt to convey an image which suits and satisfies their audience (Baumeister, 1982). SMM platforms such as YouTube allow users to collect feedback mediated by *likes* and *comments* on self-generated images and videos. This provides them with a seemingly objective measure of their success with an audience and, by extension, their self-worth (Sherman et al., 2016). As such, personal broadcasting on SMM platforms may improve self-esteem in direct proportion to *likes* received (Reich et al., 2018), with behavioural dynamics related to SPT (Taylor et al., 2017;

Sorokowska et al., 2016). In relation to CPSI, this implies that engaging in sexualised behaviour is now seen as a viable means to SMM self-validation. Compared to encouragement by a single stranger, seen in traditional grooming, this is a much more palatable gain.

The SMM 'challenge' gimmick, whereby users are playfully incentivised to perform a specific task by en-masse imitation, may be viewed as a form of self-presentation. As such, it has likely been repurposed by CPSI audiences. Our trend analysis showed a temporally well-defined onset of search interest for CPSI keywords around mid-2014, most likely sparked and/or facilitated by the viral spread of the 'Ice Bucket Challenge'. Specifically, whilst the framework has remained unchanged, the 'challenge' content has been subverted and refashioned into a powerful, reward-mediated conduit for manipulating children into providing virtually any content. The audience need only specify which 'challenge' is the most desirable, and the performers follow. Hence, 'Yoga Challenge', 'Gymnastics Challenge', 'Not my legs Challenge'.

It is worth noting that, driven by self-presentation, these children do not appear to perform under any overt coercion. This does not mean that they actually 'enjoy' engaging in CPSI behaviour, but rather that they are manipulated into falsely believing it is safe, and rewarding, to do so.

Additionally, the effectiveness of this grooming strategy is enhanced by concealing the sexual nature of CPSI content. For instance, None of the 11 keywords identified features any overt sexual references. On a purely semantic basis, they instead centre around the themes of 'yoga', 'gymnastics' and 'challenge'. Such labels are seemingly innocuous, their tone being neutral or positive, and in all cases bearing no clear relation to sexuality. We argue that this feature of CPSI keywords is part of a novel grooming strategy. As introduced, grooming is employed to normalise the establishment of an abusive relationship between offenders and victims (Katz, 2013) and facilitate the exchange of sexualised media content (AIC, 2008; Choo et al., 2008). This notion is indeed applicable to our findings. By employing harmless labels as a proxy to sexualised content, CPSI material gains a facade of legitimacy.

The true meaning of these search terms is apparent to the audience, but goes otherwise unnoticed. For instance, the terms ‘cat cow pose’ and ‘puppy pose’ are used to communicate that the relevant videos feature the performer in a ‘on all fours’ position. It may be argued that from a technical standpoint, however, there is little qualitative difference between the actual, yoga/gymnastics pose and the associated sexual position. This implies that the associated video content might easily elude any classification as ‘sexual’ by YouTube, which would in turn allow for its unmoderated distribution. It should be noted that adults also feature in similar performances under the same keywords. This content, as produced by consenting individuals of legal age, presents no issue if taken in isolation. It does however constitute a further protective barrier for CPSI, hindering detection of the latter when mixed in. Adult-equivalent videos may have also acted as an additional paradigm for children to imitate.

We also found that CPSI keywords display interrelatedness. Importantly, said property is two-sided. All search terms, in fact, both *lead* to one another and *enhance* each other’s popularity. These data suggest the presence of a strong performer-audience relationship, with both parties interacting closely through a demand-supply-reward cycle. It follows that CPSI is clearly not a sporadic occurrence. Accordingly, we showed that YouTube reactively generates a tailored selection of ‘recommended’ content (Fig. 7). Indeed, this greatly enhances the diffusion of CPSI material, and also provides apparent legitimacy to such search queries. Due to the impersonal nature of search engines, it currently remains unclear if responsibility for the inception and growth of CPSI ultimately lies with end users or the platform itself.

In further support of our observation of CPSI, previous reports suggest the occurrence of analogous phenomena on Facebook and Instagram. Rather than videos, these take the form of sexualised ‘selfies’, with varying degrees of partial nudity, occurring in both late teenagers and young women (Albury et al., 2013; Peskin et al., 2013; Strassberg et al., 2013; Ringrose et al., 2012). A substantial body of opinion holds that these photos are created by users as a form of self-presentation achieved by sexualised self-objectification

(Tiggemann & Zaccardo, 2018; Carrotte et al., 2017; Deighton-Smith & Bell, 2017; Deighton-Smith & Bell, 2017; Döring et al., 2016; Chua & Chang, 2016; Ghaznavi & Taylor, 2015; Kapidzic & Herring, 2015; Hasinoff, 2014; Manago et al., 2008).

On Instagram, similarly to YouTube, individuals post photos of themselves specifically to be seen and commented upon (Tiggemann et al., 2018; Chua & Chang, 2016; Dumas et al., 2017). The ensuing SMM reward is a potent behavioural motivator amongst young people (Foulkes & Blakemore, 2016). The number of *likes* and *comments* is displayed along with all images, functioning as a form of peer-validation (Thompson & Stice, 2001). Amongst teenage girls, the number of *likes* received is seen as a direct correlate of their objective beauty and an indicator of their social status and popularity amongst their peers (Dumas et al., 2017; Chua & Chang 2016). Several studies have demonstrated how the internalisation and enactment of ‘ideal’ standards of beauty results in direct societal benefits (Northup & Liebler, 2010; Engeln-Maddox, 2006; Herbozo et al., 2004; Malkin et al., 1999). This is so much so that the prospective of an SMM reward induces individuals to employ various strategies to actively boost the number of *likes* received on their photos, for instance applying filters or releasing content at a particular time of day. Greater self-objectification in women and teenage girls directly results in material of enhanced sexualised content, which in turn receives a significantly higher number of *likes* compared to more neutral images (Bell et al., 2018; Tolman & McClelland, 2011). In extreme cases, reports show that a number of teenage girls go as far as posting nude ‘selfies’ in order to attract attention (Mascheroni et al., 2015). The tendency to internalise standards of beauty and self-objectify is thus influenced by perceived potential benefits such as popularity, and leads to attempts to emulate behaviours seen as most rewarding (Trekels et al., 2018; Trekels & Eggermont 2016; Mascheroni et al., 2015).

Semantic analysis of CPSI comments demonstrated the employment of encouraging, positively-toned language rich in complimentary, laudatory vocabulary. Accordingly, It has been shown that positive online comments are associated with self-objectification in teenage girls (Tiggemann et al., 2018; Feltman & Szy-

manski, 2018; Cohen et al., 2017; Fardouly, et al., 2017; Slater & Tiggemann, 2015), and that a high number of *likes* on Instagram may help reduce dissatisfaction with one's facial appearance (Tiggemann et al., 2018). It follows that what could be defined as a kind of '*like* addiction' may drive self-presentation online (Mascheroni et al., 2015), with problematic dynamics over control of one's self image over time. This appears to present a challenge for children as well (Haddon & Vincent, 2014). A plethora of deleterious effects on development may arise as a result, given that in childhood the notion of self identity is unstructured, labile and easily subjected to external influences (Livingstone et al., 2009).

Our evidence indicates that CPSI victims are manipulated systemically, drawing upon the collective nature of SMM-based interactions. This results in a dangerous dilution of individual responsibility. We suspect that this seeming lack of accountability may establish and nourish a sense of impunity on the offenders' part. Further supporting this, the YouTube host platform is legal, the search terms are devoid of explicit sexual references and the content is spontaneously produced by children, in autonomy. Perceived impunity grants a layer of protection to the audience, which in turn facilitates the expansion of CPSI markets. Existing knowledge testifies to the dangers of audience impunity. It is well documented how online environments may promote disinhibition of human behaviour, particularly fostering abuse of all kinds (Quayle et al., 2014; Smith, 2012; Suler et al., 2004; O'Connell, 2003). In the context of sexual exploitation, the anonymity afforded by the web, along with the apparently 'playful' nature of many interactions may lead offenders to behave less cautiously. Specifically, this entails more open disclosure of their sexual interests and fantasies to children, along with personal information (Suler et al., 2004; McKenna et al., 2002; Quayle et al., 2001). Moreover, the relative safety enjoyed by CPSI audiences fosters inter-predator communication and exchange of ideas. Evidence suggests that this may lead to normalisation and validation of abusive behaviours (Quayle et al., 2001). If afforded protection, offenders are more likely to publicly expose their interests by directly communicating with children via comments, ultimately suggesting and requesting specific performances to fulfil their fantasies.

Generally speaking, the ability to operate from a safe distance also allows viewers to circumvent traditional protective measures granted to children by society. Predators are granted 'access' to children virtually at all times, partly thanks to the ubiquitous availability of smartphones. Whilst parents strongly regulate relationships established by their children in the real world, they are not nearly as cautious for web-based interactions (Gámez-Guadix et al., 2017a-b, 2016; Livingstone et al., 2014; Quayle et al., 2015). It follows that children may behave independently online, and with greater competence than their parents (Livingstone et al., 2007). This may lead to a process of 'reverse socialisation' in the home, leaving parents unable to appropriately supervise their children's online presence, leading to the occurrence and flourishing of CPSI content.

The findings of this study should be viewed as a representative example of the CPSI phenomenon. Our analysis is limited in size and power, and by no means systematic. The newly-exposed set of CPSI YouTube keywords most probably represents a small fraction of all existing child-produced sexualised content. The true expanse of CPSI across SMM platforms is likely several-fold greater. For instance, we have excluded non-English content from our analysis, as well as other potential search terms encompassing alternative proxy terminology (e.g. dancing). This is beyond the scope of this study, however, and is best left to future endeavours. At present our principal aim is, in fact, to simply report the existence of CPSI and delineate its core features. Still, despite the preliminary nature of these findings, we maintain that our primary definition of CPSI as an amalgamation of child enticement and SMM is likely applicable to any instance of the phenomenon.

To the best of our knowledge, CPSI has so far never been systematically characterised. We hold that its occurrence and implications deserve further study academically, as well as overall discussion at a societal level.

Conclusion: Prevention and Regulation on Youtube

In a world where availability of internet access for children is ever increasing, it is fundamen-

tal to establish preventative measures to limit the occurrence of CPSI. A UK Government White Paper named “Online Harms White Paper” was published in April, 2018 ([link](#)). New statutory law has been proposed that aims to improve the safety of young people that use the Internet, by putting measures in place to hold tech companies accountable for illegal content that is viewable on their platforms. Such measures include the appointment of an independent regulator that sets clear guidelines and is given the power to enforce these, such as by imposing substantial financial penalties if they are breached. Specific guidelines are yet to be defined. As such, the authors suggest the following possible guidelines that could, firstly, help to prevent CPSI from continuing to be published by tech companies such as YouTube and secondly, to facilitate the investigation of any criminal activity that has taken place:

1. Any account holder that wishes to post a video onto YouTube (or another similar social media website) must first upload a copy of an official ID or passport in order to prove that they are 16 years of age or over. This is to be individually validated before any user is allowed to publish videos, perhaps in a similar manner to ID checks that are employed by gambling websites.
2. A button is to be placed underneath every YouTube video that allows any user to specifically flag CPSI video content.
3. If ten independent complaints of CPSI content are made via the button described in 2 for one video, YouTube must do the following:
 - a. Internally review the video for CPSI content (using the definition provided in this study) within a specified time period, for example seven working days, and execute a definitive response within 14 working days, either
 - b. Verifying its content as ‘acceptable’ OR
 - c. Deletion of the video from the site, AND
 - d. Within a further seven days, to disclose the video to the police, as well as the account details, email addresses, names, IP addresses (where possible) and all other identifying information of the user that posted the video, as well as all per-
- sons that ‘liked’ or ‘commented’ on the video.
4. Wherever possible, efforts should be undertaken by YouTube to carry out the recommendations as in 3a-d for all historical videos that have already been removed from their website and for all videos who’s ‘comments’ or ‘likes’ have already been hidden from public view.
5. As part of an investigation into a video that is identified as containing CPSI content, all reasonable efforts must be made by the police to:
 - a. Identify the child victims of CPSI and their families so that they can be offered relevant social care investigation and support AND
 - b. Identify any perpetrators of a relevant crime.
6. Tech companies such as YouTube should be legally obliged to be fully compliant with the police in their investigations, including to release any private information that is requested of them.
7. If the names of any perpetrators are discovered by the police, those names are to be crosschecked both against interaction with other illegal videos and also against the national sex offender registry, in order to identify any serial offenders.
8. If not already done so, a national and/or international database of CPSI offenders should be established.
9. Tech companies such as YouTube must also take proactive steps to increase awareness of the potential dangers of CPSI for young people, since these companies have thus far financially profited from this phenomenon, whilst their attitude towards CPSI has been reactive at best. Specifically, tech companies such as YouTube should donate a specified amount, such as 0.5% of their profits, to an independent organisation whose aims are, for example, to:
 1. Educate children and their families about CPSI, in an age-appropriate manner.
 2. Teach and empower families how to protect their children effectively.
 3. Provide awareness talks to children in schools.
 4. Discourage children from seeking ‘celebrity’ through CPSI.
10. The authors anticipate that many victims of CPSI will suffer significant emotional dis-

stress as they approach adulthood and gain insight into the abuse that they have suffered. As such, an important area for future psychology research might be a management plan to support the victims of CPSI and any mental illness that may result.

11. There are a number of potentially serious criminal offences being committed by:
 - a. The individual viewing the material
 - b. The individual encouraging or inciting the behaviour of the child, and
 - c. YouTube itself, by making/ permitting/ inciting and/or distributing indecent photographs of children (CPSI).

Ultimately, the decision about whether to embark on a criminal prosecution should be made based upon local legislation.

Countermeasures undertaken so far

1. We have created a Gmail/Youtube account under the name CPSIreporting@gmail.com, and are in the process of reporting as many videos as possible, stating as the reason "this is child-produced sexualised imagery, defined as etc." We will continue to report as many videos as feasible. Our aim is to report at least 50 videos a day. We invited all readers to do the same.
2. A report to UK police has been made.

Figure legends

Figure 1 (A) Table summary of 11 CPSI keywords under examination. Approximate total number of search results are accurate as of August 2018. This preliminary list is by no means exhaustive, and should be viewed as a representative example of the nature of CPSI content. (B) Prevalence of CPSI videos by keyword. For each search term, the percentage of CPSI videos amongst the 50 most 'relevant' results is shown (red bars). CPSI prevalence for a control keyword (letter 'A') is also shown in comparison (blue bar). The high prevalence of CPSI demonstrates the content-specificity of all keywords reported. (C) Diagrammatic summary of the logical step-wise process employed to formulate the CPSI definition then utilised to hypothesise and verify its existence.

Figure 2 CPSI search interest trends over the last decade. For all keywords, Google Trends was interrogated (Aug 2018) to quantify worldwide, YouTube-specific search activity. (A) Differential search interest for all CPSI terms combined, showing significantly higher traffic over the 2014-2017 time window (red squares). In contrast, interest for a control term (letter 'A') did not vary significantly (circles). (B) Overview of CPSI search interest by year. Trend data for each individual term are displayed (grey lines) along overall average interest for all terms (red line), demonstrating a clear onset of activity in mid-late 2014. A control trend (letter 'A') is also shown in comparison (blue line). (C) Postulated 'trigger' event for the establishment of CPSI search interest. A short-lived spike in YouTube activity for the term 'Ice Bucket Challenge' is shown (blue line) to exactly match the rise of CPSI search interest in mid-late 2014 (red line).

Figure 3 CPSI keyword relatedness network. Google Trends 'related search' data for each term was employed to assemble a network, demonstrating a high degree of interconnectedness amongst CPSI keywords. Each node (red circles) represents a search term, whilst edges depict related search suggestions (black line). Node size is determined by edge number. Starting from any one term, all nodes can be reached within three related searches.

Figure 4 Correlation heat map for CPSI terms. Differential search interest over time (2008-2017) was compared between any two keywords via Spearman rank analysis. All CPSI terms significantly varied in robust positive correlation with one another (red cells). In contrast, no correlation was found between all terms and a control trend (letter 'A', white cells).

Figure 5 Semantic analysis of adult audience comments ($n = 1398$) sourced from a selection of CPSI videos ($n = 30$). The Cirrus word graph reported displays the most frequently occurring words employed by commenters, revealing a distinctly encouraging and manipulative tone, mostly based on terminology with positive connotations (eg.: *love, good, pretty*). Word size positively correlates with occurrence for visualisation purposes.

Figure 6 Example of child-audience interaction via direct comments on a CPSI channel, demonstrating the important role of 'like'-mediated rewards.

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